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INVERTEBRATE ZOÖLOGY · ANTHROPOLOGY · PHYSIOLOGY · EDUCATION
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THE AMERICAN MUSEUM OF NATURAL HISTORY

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NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM

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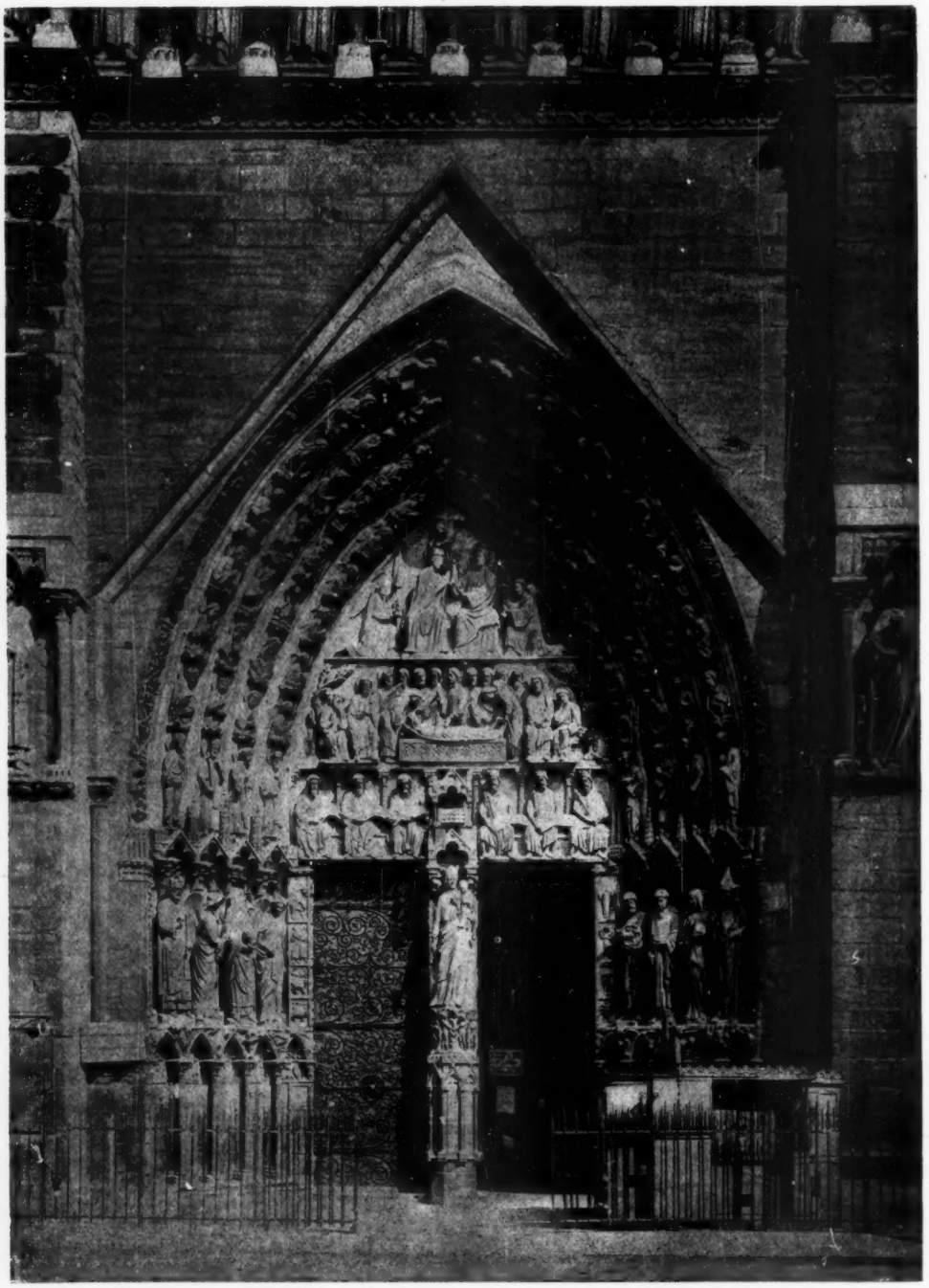
DRAWING AND NOTES BY ALEXANDER WILSON

Among the valued possessions of the American Museum is a yellowed paper, bearing this drawing in color of the head of the great white crane, and this description, the work of the pencil and brush of Alexander Wilson in 1808, five years before his death. The document was given by Wilson to George Ord, his friend and the companion of many of his field journeys, and came to the Museum in the effects of Titian Peale (youngest son of Charles Willson Peale, another naturalist friend of Alexander Wilson and George Ord—see p. 211, AMER. MUS. JOURNAL, March, 1917). It is a pleasure to give a reproduction of the plate in this issue of NATURAL HISTORY which prints James Lane Allen's story of the life of Wilson (p. 397)



PORTAL OF NOTRE DAME TO ILLUSTRATE SCULPTURE IN CORRECT RELATION TO ARCHITECTURE

The world rejoices with France that the war did not reach Paris

Every figure in this portal of the Cathedral of Notre Dame, in Paris, expresses with infinite skill the beauties of Gothic architecture—the pose of the heads in the tympanum, the lines of the draperies and the shadows are all designed with reference to the structure. Even the voussoirs of the great arch are expressed by the shadows under the canopies over the saints' heads. The central post is the acme of architectonic sculpture

—From "Zoölogical Sculpture in Relation to Architecture," page 449

NATURAL HISTORY

VOLUME XIX APRIL–MAY, 1919 NUMBER 4–5

New College of Fisheries in the Northwest

DEPARTURE IN TECHNICAL EDUCATION PLACES AMERICAN FISHING INDUSTRIES ON A SCIENTIFIC BASIS

By HUGH M. SMITH

United States Commissioner of Fisheries

THE recent establishment by the University of Washington of a college of fisheries is of such importance as almost to mark an epoch in the history of technical education and in the development of the fishing industry in America.

This event is of great interest to the United States Bureau of Fisheries because the bureau welcomes every agency that extends knowledge of and increases concern for the welfare of the American fisheries and the creatures which make those fisheries possible—and also incidentally because the director of the college is a former valued assistant of the bureau. The founding of the new college is particularly pleasing to the present commissioner because of his long and continued advocacy of technical instruction in fisheries and because it is the outcome of a special recommendation to and conference with the authorities of the University of Washington.

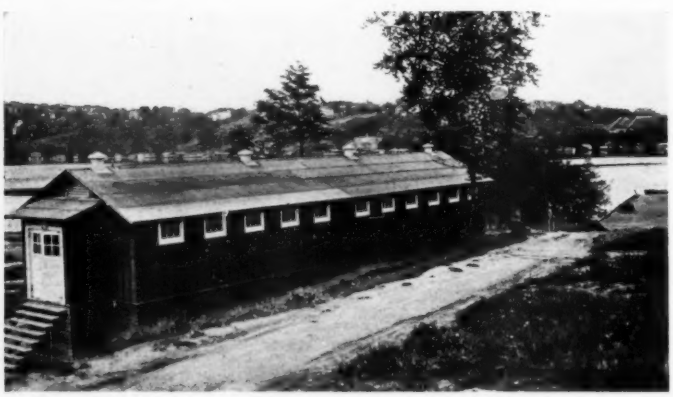
The new college of fisheries provides a four-year course, divided into three sections, namely, commercial fisheries, technology or the methods of preparing aquatic products for foods and for use in the arts and industries, and aquiculture. The instruction will be both didactic and practical, but for the last two years of the course the students will be expected to devote a large part of their time to practical training at fishing establishments and fish hatcheries.

The college has a strikingly fitting environment. Seattle is the principal city of one of the great fishing states, and, as pointed out by the university authorities, is the only American city within whose corporate limits or in territory immediately contiguous may be found in active operation practically every type of plant for turning raw aquatic materials into human food and other useful commodities. Fishery operations are conducted in the very harbor of Seattle; the great fleets of vessels resorting to the Alaska fishing grounds make Seattle their principal headquarters for outfitting and for discharging their catch; the salmon fisheries of the Puget Sound - Fraser River - Strait of Fuca system are the most valuable in the world. Internationally the region is of special fishery interest. The Fraser River, the principal red salmon stream in the world, is in British Columbia, and all the spawning grounds of the red salmon frequenting the international waters are in the Canadian province, while the major part of the annual tribute exacted by man from the salmon schools is taken in Washington. From the fish-cultural standpoint, the operations by nation and state in the waters of Washington are on a scale of almost unequaled mag-

Panoramic view of part of the campus at the University of Washington, showing Meany Hall and (on the opposite page) Science and Denny halls. The University is expanding its present instruction in ichthyology into a technical college of fisheries to train fish-culturists for government and private fishery work

nitude, and every species of Pacific salmon abounds, spawns, and is artificially propagated in the local streams. The wide expanse of waters that may be regarded as the real campus of the fishery school is rich in other life, and ample material is afforded students for work on the anatomy, physiology, embryology, and life history of important creatures whose conservation is a matter of public concern.

A practical point in connection with the college of fisheries is that the graduates in the various courses may expect to find congenial employment in national, state, and private fishery work. The demand for fish-culturists has far exceeded the supply in recent years. The need for young men and women qualified in aquatic zoölogy, in the use of fishing methods and appliances, and in the technology of fishery products and by-products is very real and is certain to increase. In the fishery department of every state, there should be, as a part of the permanent staff, men with expert knowledge bearing on all the duties and problems that arise in connection with the administration of the local waters and their inhabitants.[1] Some states have already realized and acted on this responsibility; other states may be expected to fall in line as the growth



The Hatchery Building of the newly established College of Fisheries is situated on the government canal connecting lakes Union and Washington. Regular instruction and research in the subject of fisheries begin at the new fall term when two new professorships are to be established to amplify the work of the zoölogy department in this line. Coöperation will also be effected with government agencies and private industries

[1] In this connection, see one phase of necessary expert knowledge in Prof. Baker's article on "Fresh-water Farming," pp. 479–488.—THE EDITOR.

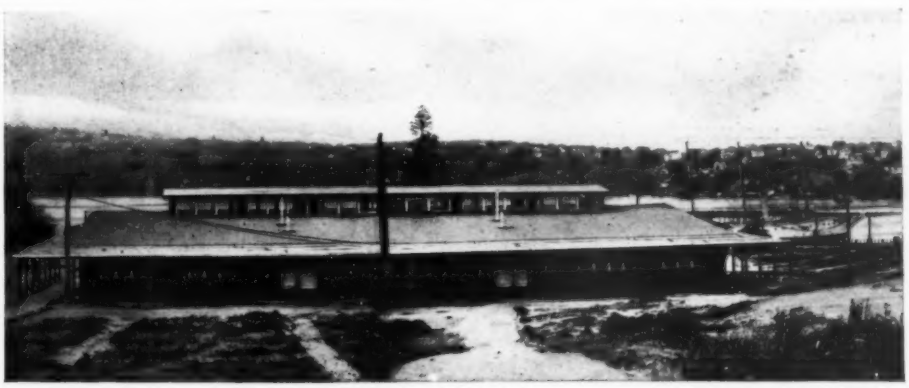
The University of Washington is most favorably situated for the study of fisheries. Seattle lies in the center of the great northwestern fishing industry, and is the headquarters and discharging station of the Alaska fisheries

of public sentiment demands it and as qualified assistants become available.

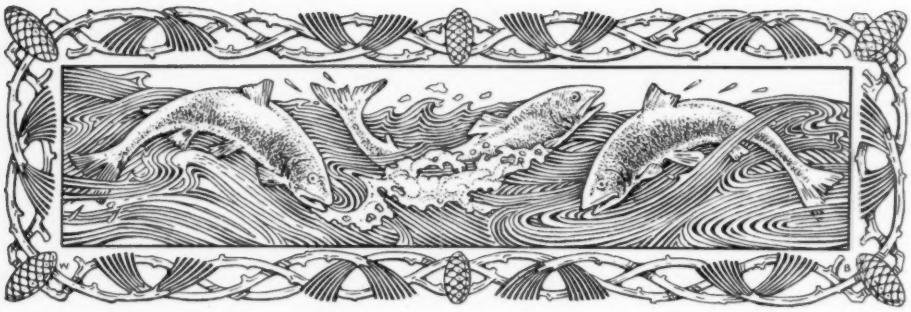
The University of Washington, while entitled to all the prestige and honor that deservedly belong to it as a pioneer, should not indefinitely enjoy a monopoly of a college or school of fisheries. Other universities favorably situated should follow suit; and at the present time there should be serious attention given to the establishment of such institutions on the Atlantic and Gulf coasts, on the Great Lakes, and in the Mississippi Valley.

Colleges of fisheries, through the influence they exert at large and through their graduates, can do much to guide fishery legislation and should become potent agencies for molding the public sentiment that should be back of all beneficent laws for the conservation of aquatic resources and the regulation of the industry. An improvement in the quality of legislative fishery measures should confidently be expected through the working of the leaven of fishery graduates in all parts of the country.

One of the chief boons that colleges of fisheries can hope to confer on fishery work throughout the country will be the substituting of accurate observations and sound biological principles for the unscientific methods that have often characterized fishery procedures.



Fisheries Hall, University of Washington.—The campus extends to the edge of lakes Union and Washington and the scientific work of the university can be closely connected with the practical work in fisheries



The Red Salmon

A FISH WITH AN INSTINCT FOR LAKE WATER

By DAVID STARR JORDAN

THE habits of the red salmon (*Hypsifario nerka* Walbaum) are absolutely unique among fishes. The fish casts its spawn in the fall, but only in small streams tributary to some lake. After hatching, the young fishes slip downward tail foremost, with the current, into the lake. There they mostly remain through the first year, then dropping downward, head always against the current, to the seas.

In the sea they remain until the fourth year, when they start upstream to the spawning grounds. Whether they go to the same grounds or not, no one knows. The idea that they do reach substantially the same streams is borne out by some evidence. Yet that this instinct should be minutely accurate is not conceivable.

After entering the river, the fish feeds no more. The digestive organs shrivel and the fat and cell-substance are gradually consumed. On arriving at the spawning grounds, the fishes, male and female, are battered and exhausted. The jaws are greatly elongated in the male, the front teeth enlarged, and the color changes from clear blue to dark dull-red. On the way upward the fishes pair off. The male scoops a furrow in the sand or gravel. The female fills it with eggs. The sand is smoothed over, after which the fishes drift back into the current and float downward "tail foremost in the old salmon fashion," every one dying in the course of a week or so, none ever reviving or reaching the sea.

A few spawn prematurely at three years; others are belated and spawn at five years, these being of larger size than the others which range from about seven to eight pounds.

The age of the salmon, as Dr. Charles H. Gilbert has demonstrated, can be determined by the study of the scales. The scales are marked by close-set concentric rings of growth. These are widest apart in the summer, when feed is best, and become close together in the winter. By these, the age of the fish can be ascertained, in a fashion analogous to finding the age of a tree by its rings of growth.

The most remarkable fact is that the red salmon never enter a stream which has no lake. So far as their range goes, northern Japan to Bering Strait and south to Oregon, there is not a stream with a lake which they do not enter. And the time of starting to run in the spring bears some relation to the

distance they have to go. In the Yukon, the first lake, Labarge, is about fifteen hundred miles above tidewater. Yet red salmon reach the head of Lake Labarge. Another notable salmon stream is at Boca de Quadra in southern Alaska, not a mile long, less than ten feet wide, and shallow at that. It heads in a beautiful lake with fine spawning grounds, and the stream is crowded with red salmon.

The red salmon (locally called "blueback") runs in moderate numbers in the Columbia, a river with few lakes. At one place, above Umatilla, there is a bridge across the forks of a tributary, one branch heading in a lake, the other without a lake. From this bridge, Dr. Gilbert has watched the two species of salmon as they run. The bluebacks all turn toward the lake, while the Chinook salmon (*Oncorhynchus tschawytscha*) move apparently indiscriminately either way.

No one has ever seen a red salmon in any lakeless river. Mr. J. P. Babcock, Fish Commissioner of British Columbia, tells of an experiment of piping water from the outlet of a lake into the sea. The red salmon gathered around the mouth of the pipe, as though recognizing the peculiar kind of water, though they naturally could not ascend the pipe.

It is probable indeed that the salmon has some sort of instinct by which it recognizes lake water in whatever form. It makes no difference whether it is ice-cold and milk-white from the foot of a glacier as in Chilkoot River, or clear spring water as in the Boca de Quadra or at Yes Bay.

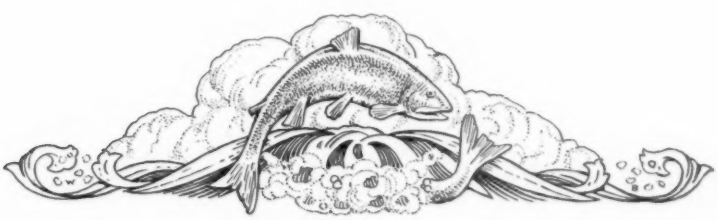
A certain number of red salmon never leave the lake. These mature at a weight of a pound or two and at first were naturally taken to be a distinct species (*Hypsifario kennerlyi*). Such dwarf lake-locked salmon are found in almost every deep lake from Idaho around to northern Japan.

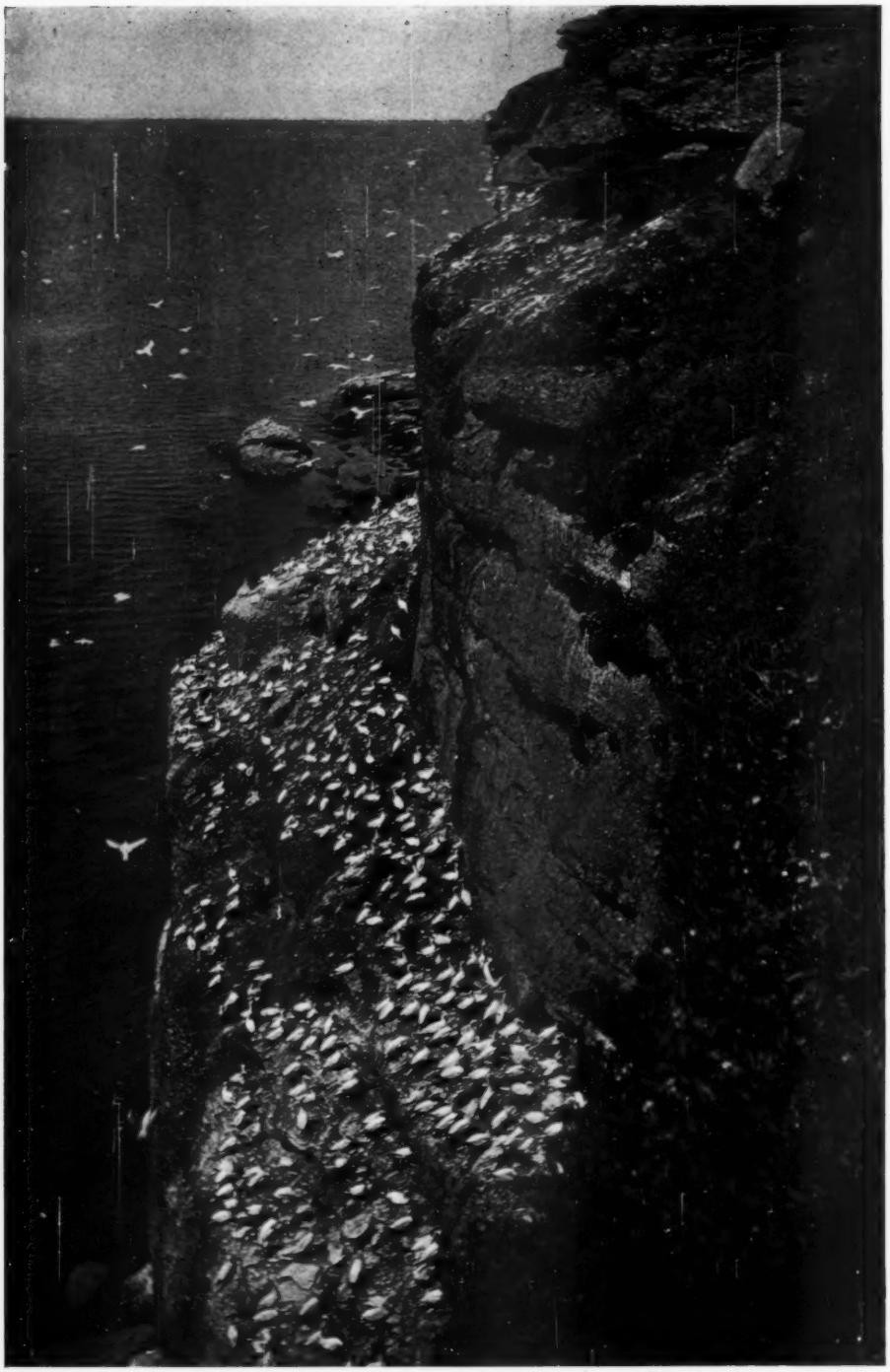
By some unexplained freak, the run in Puget Sound and Fraser River is every fourth year about double the ordinary run. The cause of this goes far back into the history of the species and is unexplained.

In Puget Sound, the humpbacked salmon (*Oncorhynchus gorbuscha*), which lives but two years, runs in enormous numbers on alternate years, being almost wanting in the odd year. Neither species shows this trait of alternation in any waters other than Puget Sound.

The red salmon is known by various local names as "Krasnaya Ryba" (redfish), "nerka" in Alaska and Kamchatka (although none of us has ever heard it so called), "sockeye" (Sukkegh) in British Columbia, and "blueback" in Oregon. Its flesh is not so pleasant to the taste as that of the much larger Chinooks, but it is redder in color and therefore sells better.

The red salmon is the most valuable single species of fish in the world, as it occurs in uncounted numbers especially in the streams about Bristol Bay, the Karluk River of Kadiak Island, and in the Fraser River of British Columbia.





Photograph by A. J. Cramp

THE SHEER CLIFFS OF BONAVENTURE

The cliffs of Bonaventure are exceedingly difficult of access and many of these photographs have been made only at great risk. This is one of the broader gannet ledges. Happily, the races of sea birds that frequent this remarkable breeding place have now come under government protection in Canada by the law just passed establishing Percé, Bonaventure Island, and the Bird Rocks as bird sanctuaries. Thus are saved to the world certain species of water fowl which were rapidly becoming extinct

The New Gaspé Bird Sanctuaries

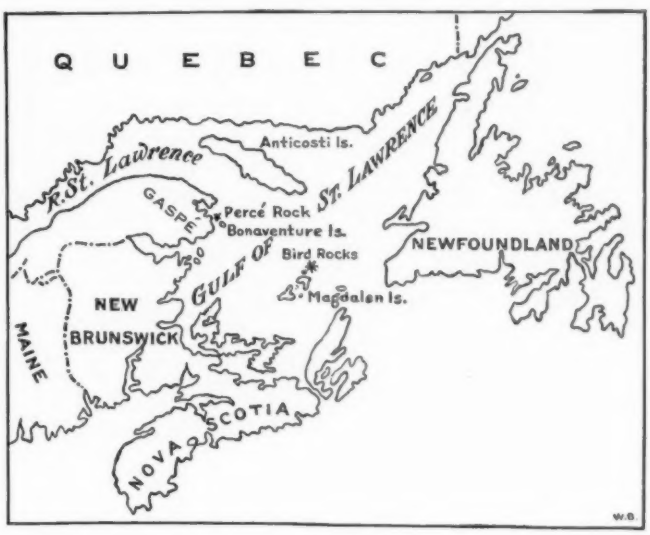
By JOHN M. CLARKE

State Geologist and Palæontologist, and Director of the State Museum, Albany

FOR nearly four hundred years the navigators of the Gulf of St. Lawrence have wondered at the immense colony of sea fowl which nest upon the ledges of the Isles-aux-Margaulx—the "Bird Rocks," as they are known to modern English geography. These remote bits of bare rock lie about ten miles to the north of the Magdalen Island group, and as they are constituted of the same rocks, they must be assigned to the same little archipelago.

The Bird Rocks are three in number now. In the early days the two little fragments now called the "Little Birds" were one, but the sea has broken them apart. The "Great" or "Northern Bird" is a flat rock table, not so large as some ice floes, with sheer vertical walls on all sides, rising one hundred and fifty feet from the water to the base of the lighthouse which constitutes it the lone outpost of civilization. Ever since the days when Audubon visited this spot on his voyage to the Labrador, the islet has been the object of much visiting, collecting, and writing by students of birds. It is probable that a century ago the bird colony here was the largest on the Atlantic Coast, but this is no longer true, for, while the inroads of the eggers which so depleted this colony and brought to extinction many of the bird colonies on the Labrador have ceased, other damage has been done; partly because the presence of the lighthouse with its noisy accessories for warning vessels of their proximity to the rock has helped to diminish the census of the bird population; partly from the invasions by the Magdalen Island fishing fleet; and the greedy "bird lover" who collects birds' eggs "for exchange" is not without blame in this matter.

The Great Bird Rock, in spite of its isolation and remoteness, is an island gem of much beauty; its level grassy top covers about seven acres of ground, and aligned on all the ledges which make up its gray steplike bastions are the ranks of gannets, the most beautiful of all waterfowl; of murres and kittiwakes; of guillemots, razor-billed auks and puffins; a short list of species



The Gaspé Bird Sanctuaries.—Percé Rock and Bonaventure Island, off the Gaspé Peninsula, and farther out in the Gulf the Bird Rocks of the Magdalen Island group, have been for centuries the breeding places of several species of birds which rarely or never nest on the mainland. These rocky islets, because of their isolation, are ideal resorts for sea fowl

The beautiful village of Percé at the point of the Gaspé Peninsula faces squarely the waters of the Gulf of St. Lawrence. It is one of the oldest settlements in eastern North America, having been established as a fishing station before the year 1600. Percé Rock, which lies off the point of Mt. Joli, often figures in the relations of the early navigators and missioners. Bonaventure Island, in the background, is also an ancient station and had a church as early as 1671

Photograph by A. J. Cramp

Bonaventure Island is in itself an object of great natural beauty and during the tourist season is visited daily. A climb to the summit from the wharf on the low western shore affords an effective distant view of the gannet ledges, while the boat trip around it gives a close view of its feathered community, considered one of the wonders of the Atlantic Coast

Photograph by A. J. Cramp

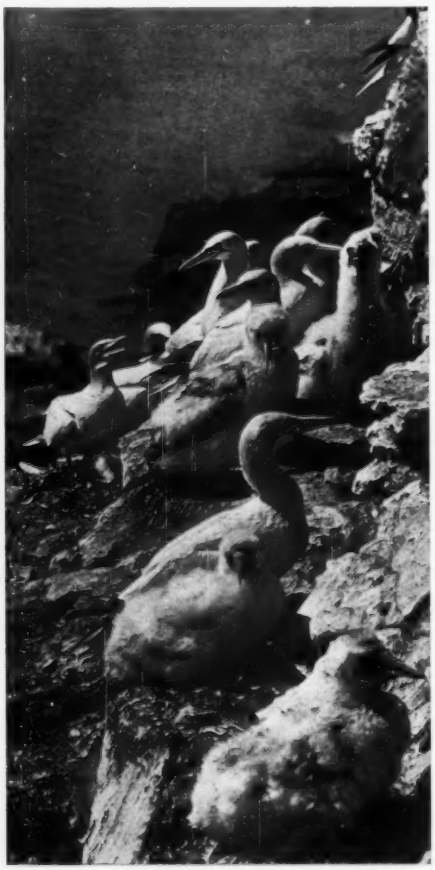
The verdure-capped summit of Percé Rock is the home of a colony made up of herring gulls and crested cormorants. This assemblage has been here since the beginnings of human history on the coast, and the upper surface of the rock has never, so far as records show, been the breeding place of any other species. This picturesque and beautifully colored mass of vertical Devonian limestone is here viewed from the summit of Mt. Joli on the mainland. It is approximately 300 feet high, 1200 feet long, and 80 feet wide. Toward the sea end the rock is pierced by an archway which frames the waters of the Gulf beyond

Photograph by F. M. Chapman

Great Bird Rock is the only known rookery of the gannets outside of Bonaventure Island, on this side of the Atlantic. It has no human population except the lighthouse keeper and his assistants. When the Bird Islands were discovered by Jacques Cartier in 1534, the "Isles-aux-Margaulx" as he named them, housed an enormous colony of water fowl. When Audubon visited the place, however, in 1833, he found that the attacks of eggers here and elsewhere, particularly on the Labrador coast, were resulting in the sale in the Boston and New York markets of hundreds of thousands of dozens of eggs annually. These attacks have undoubtedly been the cause of the extinction of the gannet roosts on the islands and coasts of Labrador

but an association of most ancient date.

The romance and tragedy of the bird life of this colony have been depicted both by camera and pen. Few more effective pictures of birds have been made than the photographs taken here by Herbert K. Job and Frank M. Chapman who risked limb and life in the acrobatic performances necessary to catch their effective views. And these were pictures taken when such photography was a new and perilous adventure without the help of telephoto lenses or long distance electric connection. It was here that Louis A. Fuertes went for subjects for his paintings of the "Birds of New York," and these ledges furnished the setting for the Bird Rock Group in the American Museum of Natural History.



Photograph by L. D. Bostock

Fledgling gannets on the Bonaventure Island ledges.—The young when hatched are naked and helpless. A white down soon appears; at a year old the plumage is a smoky brown with white V-shaped spots, which finally gives way to the pure white of the adult

A still larger colony of these waterfowl is that on the cliffs which bound the eastern face of Bonaventure Island, lying two miles out in the gulf from the point of Percé, the easternmost projection of the Gaspé coast. Bonaventure Island is nearly circular and about a mile and a half across. It is another insulated remnant of tableland, like the top of a round center table tipped down to low shores at the west but with high and vertical edges rising four hundred feet at the east. It is on these steepest, most elevated, and most inaccessible ledges of the island that the greatest of all the bird colonies left in the gulf makes its breeding home. Until late years these birds have never been subject to the assaults which have so gravely impaired the census of the Bird Rock colony.

Bonaventure is a continental island and strictly within the control of the mainland, so that the eggers of the Gloucester fleet who in the old days made their regular inroads upon the colonies farther out in the gulf and carried back to the Boston market hundreds of thousands of dozens of eggs every spring, were not sufficiently venturesome to invade these mainland limits. On Bonaventure the damage done has been partly through the egging carried on by the local fishermen, but of late years, as the beautiful Percé country becomes annually a more favorite resort for tourists, there have been increasing and ruthless attacks upon the nesting birds by the "fool with a gun," who has slaughtered for the sake of slaughtering and shown his sporting blood by enfilading from a distance squads of harmless waterfowl nesting upon their young.

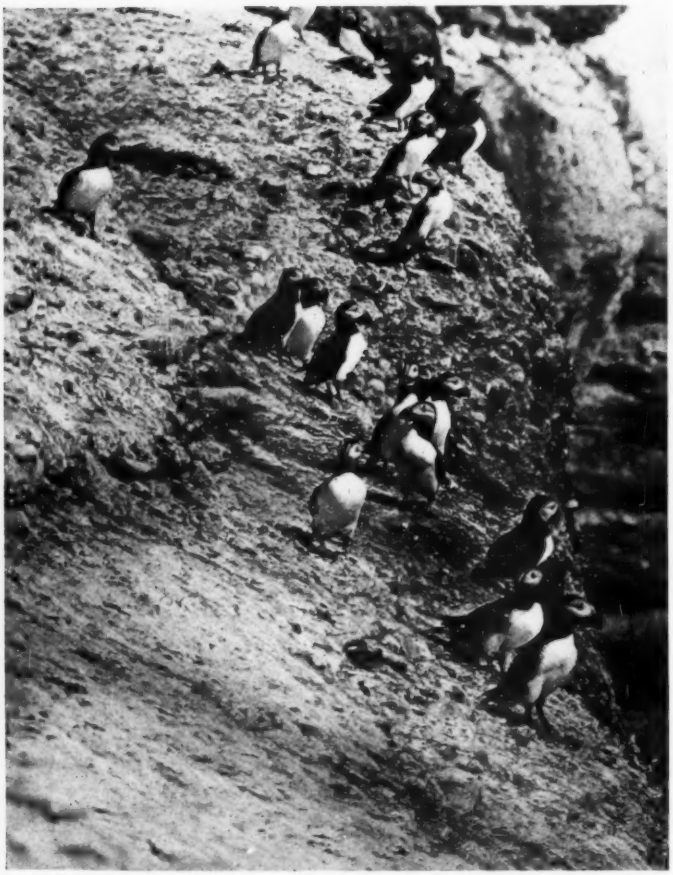
The bird colony at Bonaventure

Island is of quite the same composition as that of the Great Bird Rock, and it is perhaps nothing more than an interesting coincidence that these two great colonies, constituted of the same aggregation of bird species, have chosen to bring forth their young upon the same kind of conglomerate and sandstone rocks of the same gray and red color, all of the same geological age and formation and having the same horizontal position. Mr. P. A. Taverner, of the Geological Survey of Canada, has estimated, from a series of photographs, that the population of the gannets alone in the Bonaventure colony is between 7000 and 8000, a very much larger number than that assigned to the gannets of the Bird Rock colony.

The third of these notable Gaspé bird colonies is that on the top of the Percé Rock. This celebrated and dramatic rock island lies close upon the coast line of Percé village and is in itself the most extraordinary scenic feature on all the Atlantic Coast—a mass of vertical limestone tinted with red, yellow, and purple, with undulating verdure-capped summit, and it is the wavy top that is the abode of a colony composed of two species of birds,—the herring gull and the crested cormorant. Ever since the days in the late years of the sixteenth century, when the fishermen from Brittany and the Bay of Biscay

Photograph by F. M. Chapman
Courtesy of D. Appleton and Company

The nesting mother gannet (*Sula bassana*) on the conglomerate ledges of the Great Bird Rock, overlooking the Gulf of St. Lawrence. This bird, often called the solan goose and taking its Latin name from its best known home on the Bass Rock near Edinburgh, is the largest and most beautiful of our salt-water fowl. The body of the adult bird is almost entirely white, the wing tips being black, the neck and head washed with buff, and the bill bluish gray



A group of razor-billed auks on the ledges of the Great Bird Rock of the Magdalen Islands.—This bird is the nearest relative of the extinct great auk which at one time also inhabited Great Bird Rock

began their operations at this celebrated fishing port, the cries of the sea birds have been the familiar accompaniment of the life of the coast and the gulls of Percé Rock an historic part of the living scenery of the coast. No one kills a herring gull except a hungry fisherman whose palate does not yet resent the fishy flavor of the fluffy young bird stumbling about the beaches. The Percé Rock is unscalable and thus the birds have had a fair natural protection, but their greatest protection has, I think, lain in the fact that here close upon the shore they have always been kindly regarded by the people of the place as their natural neighbors and helpful scavengers for dirty beaches. The coming of the gulls and their departure mean to the people the promise and the farewell of the summer.

All of these territories are in the Province of Quebec and the County of Gaspé. On the seventeenth of last March a bill which had been introduced in the Quebec Parliament for the purpose of establishing these colonies as protected bird sanctuaries became a law. In many respects the law is a very extraordinary enactment, for it is frankly based upon recognition of the "rapid and alarming decrease in the number" of these birds by which there has resulted a "threatened extinction"; and because these are "almost the last resorts of certain vanishing species . . . interesting to all lovers of nature and science and valuable as scavengers," the law has been framed and passed with sentiment paramount and human economy taking a secondary place.

The birds are protected to prevent them from vanishing, because they are interesting and wondrous creations of great beauty, and incidentally because they are valuable as scavengers. Perhaps in the entire history of bird legislation in the western continent no other regulative measure, so essentially based upon the higher sentiment of the community, has been enacted, and for

Photograph by P. A. Taverner

GANNET COLONIES OF BONAVENTURE

The great gannet colony of Bonaventure Island is separated into two companies. The observer approaching the island from the north first comes upon the lesser colony; then a hiatus follows of barren rock cliff before the second and larger colony begins. It seems possible that this uninhabited interval owes its existence to a great rock fall in the remote past, which blotted out for its bird inhabitants all memory of their former nesting places

Photograph by F. M. Chapman
Courtesy of D. Appleton and Company

Gannets, murres, and puffins on the horizontal rock ledges of the Great Bird Rock, Magdalen Islands. In view of the years of persecution to which these birds have been subjected, they are still remarkably tame

this reason the law stands tremendously to the credit of the parliament and the people of Quebec. It is a stringent law; it takes under its cover all the migratory game birds and migratory insectivorous birds as well as the migratory nongame birds, in pursuance of the migratory bird law, this being an important but actually an incidental part of the legislation.

To the sanctuaries thus created we have been referring: the Bird Rocks and a one-mile zone surrounding them; a strip of land on the north and east sides of Bonaventure Island, ten feet in depth along the cliffs with the face of the cliffs itself, this provision protecting all of the nesting places with but slight encroachment upon the woodlands there under private ownership; and the Percé Rock with a one-mile zone about it. Severe penalties are imposed for offenses against this law.

After the perfection of this enactment, an order was issued by the Governor General in Council (March 29) to the same effect so far as the Bird Sanctuaries are concerned, thus giving to the reservations a national recognition.

The history of the movement which has led up to this result is not without its interest. About six years ago the anglers of the Gaspé district made joint allegation to the Ottawa government, regarding the depredations by the crested cormorant upon the salmon and trout pools. The indicted bird was accused of being the greatest enemy of the young of the fresh-water game fishes, and as the cormorant colony on the summit of Percé Rock is the only large nesting ledge of its kind on the coast, the game inspector, the late Commander William Wakeham, was officially ordered to destroy these birds. He made arrangements to carry out this order by having the Percé Rock scaled, the young birds killed, and the nests destroyed, although it is within my personal knowledge that he did this with utmost reluctance. It seemed then a proper time in which to enter a demurrer so far as could properly be done until the indictment against the cormorant could be tried out.

Ornithologists were not at all dis-

posed to unanimity in regard to the natural food of the crested cormorant, nor were they willing to grant that the indicted bird was guilty of the crimes laid at its door. In order to determine this matter and in view of a more official protest against the procedure referred to, the Ottawa order was rescinded until such time as the ornithologists of the Natural History Survey of Canada could enter upon and conclude an investigation of the habits of the cormorant. Mr. P. A. Taverner, with his assistants, was detailed to make a special study of this problem on the ground, and as a result of the inspection of the ingested food of these birds, he rendered judgment that the cormorant was not guilty. Mr. Taverner's examinations, however, extended much further than to a solution of this problem; he gave close attention to the other birds of the Percé colonies, and he, too, perceived and emphasized the adverse conditions under which the birds were maintaining their existence.

The long campaign which has at last come to so fine fruition had for its effective conclusion the initiative of the Honorable Honoré Mercier, the Minister of Colonization, Mines and Fisheries for the Province of Quebec, and the provisions of the law were drawn by Mr. E. T. D. Chambers, of Quebec, whose sympathy in this undertaking was of prime moment.

I think it safe to say that the crested cormorant is the sacred bird which has saved the day for these St. Lawrence nesting places and, like many another martyr in a good cause, is itself alone left outside the pale of the protecting ægis. A black bird seems to have plenty of trouble under any of the protective laws.

The Province of Quebec now has a great bird reserve of the most attractive sort. The Percé Rock and the Bonaventure Island cliffs are of themselves objects of great natural beauty. The Percé Rock is ever startlingly under the eye. Bonaventure Island lies in the offing like a great green whale revealing nothing of its bird wonders to the man ashore. The boat trip around it beneath its sheer rock walls is the lifting of the veil to its most impressive feathered community. To the Bird Rocks of the Magdalens it is about 124 miles, into the heart of the gulf, a pleasant two-days' journey by boat from Percé with agreeable weather. Such a trip is not possible under present arrangement but it may be within the power of the Province which has gone thus far so well, to arrange such voyages over its great Marine Park.

Photograph by F. M. Chapman
Courtesy of D. Appleton and Company

"Bird Rock" is about seven acres in area, with grassy top and weathered, precipitous sides. The lighthouse keeper and the birds together keep watch here at the entrance to the Gulf of St. Lawrence

MAN-O'-WAR BIRDS OF LAYSAN

The frigate or man-o'-war bird (*Frigata aquila*) has a bright red gular pouch, an inflated air sac only indirectly connected with the lungs, so that it can be filled or emptied but slowly. When the bird is on the wing the red pouch bobs from side to side, giving a most bizarre appearance. These birds are adroit fliers. It is while on the wing that they gather twigs for the nest, catch surface-swimming fish, and even drink water, catching it up as they dart downward in long parabolic curves. The frigate birds are numerous on Laysan, and maintain a piratical warfare on their neighbors, the blue-faced boobies, who are skillful and industrious fishermen. The boobies are set upon when coming in from the sea laden with flying fish, and are rudely overturned in mid-air, a procedure which invariably cau[illegible] them to drop the fish—which the man-o'-war birds scoop up as they fall. Afterward, the members of the expedition turned the tables and collected good specimens of flying fish for scientific study from the man-o'-war birds by rapping them lightly on the head with a cane, thus causing the birds to disgorge the fish.

Laysan is the largest of the chain of islets running to the northwest of the main Hawaiian group, set aside by President Roosevelt in 1909 as a bird reservation. The islands are formed by the summits of a great submarine volcanic mountain range. Like most of these islands Laysan is probably an old atoll with a surrounding reef and central lagoon. Nowhere does it rise more than fifty feet above sea level. Tall, bushy grass and shrubs cover its inner slopes, supported by a soil formed through the disintegration of coral and phosphate rock. At one time it was reported that there were several palm trees on the island but our expedition found only dead stumps of palm trees

Laysan's fringing reef over which the long Pacific rollers break.—The reef is open only on the western shore, where landing can be easily effected in favorable weather

Notes on Our Hawaiian Reservation[1]

By ALFRED M. BAILEY

Curator of Mammals and Birds, Louisiana State Museum

OUT in the mid-Pacific, extending from the main Hawaiian group in a northwesterly direction for fifteen hundred miles, are a series of small islands famed the world over for their vast number of long-winged sea birds. These islands are reached by boat from Honolulu and as one proceeds on the way to the famous bird paradises and sails past the green slopes of Kauai and Maui without seeing a feathered creature except possibly a man-o'-war bird dark against the sky, one wonders why these other favorable places in the beautiful Hawaiians are not occupied by a greater bird population.

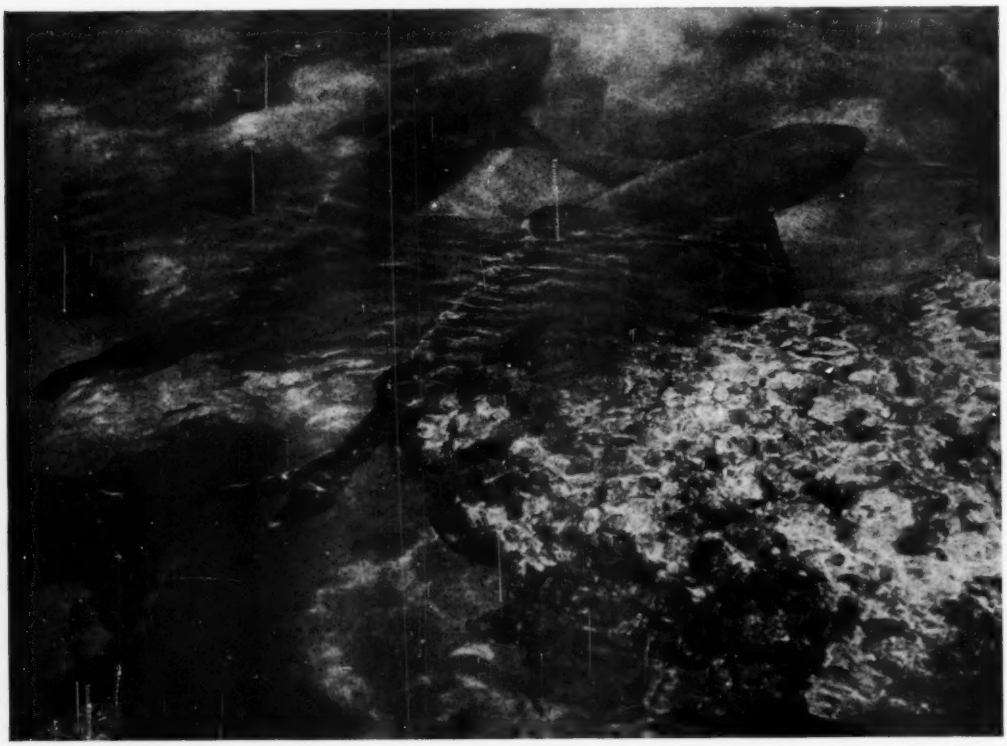
We left Honolulu December 16, steaming close to verdure-covered Kauai as we circled off toward Bird Island. This we reached the morning of the second day out. It is a precipitous little mountain, a mass of rock towering sheer for nine hundred feet, one portion crumbling to the water's edge, and the gentle interior slope like the bowl of a timeworn volcano. Thousands of birds, flashes of white against the dark blue of the Pacific and dark against the light of the sky, drifted out to meet the on-coming boat. A few albatrosses were seen skimming the waves, and wide-stretching man-o'-war birds drifted lazily above the mast tops, circling rings about the boat with no apparent wing movement. We found that landing on Bird Island was impossible, owing to the tremendous surf

[1] The Hawaiian Islands Reservation was established in 1909 by Executive Order as a sanctuary for the millions of sea birds and waders which return there annually to raise their young or to rest while migrating.

An earlier article by Mr. Bailey, describing the discovery on Pearl and Hermes reefs of the main rookery of the rare monk seal, was published in the May, 1918, AMERICAN MUSEUM JOURNAL.

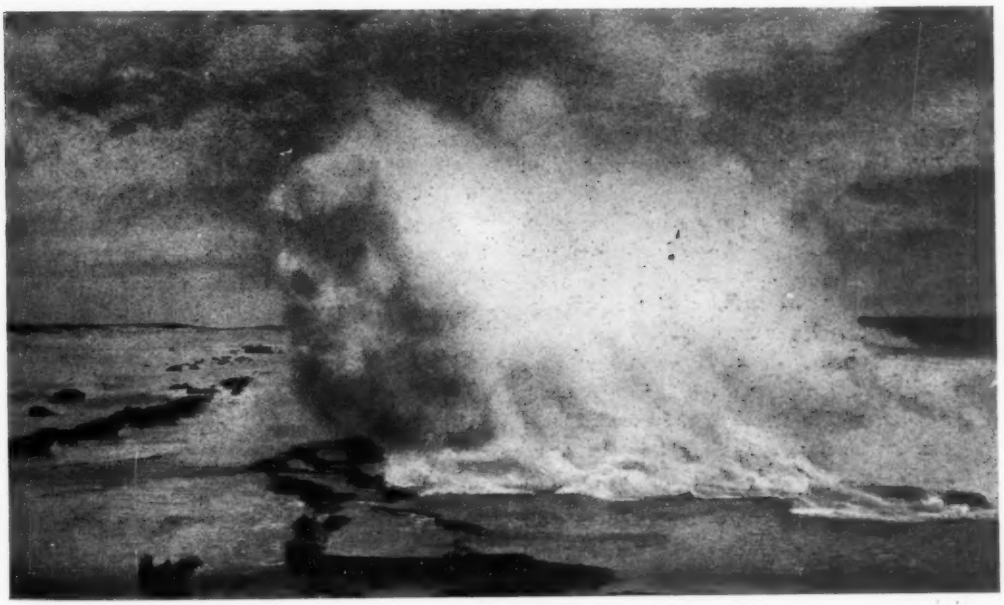
Illustrations from Photographs by the Author

The Hawaiian terns (*Micranous hawaiiensis*) are confiding birds and dart about the head of the visitor to their island in a fearless manner. They nest in large colonies among the matted bushes, making long excursions offshore for the fish on which they almost entirely subsist. These terns do not dive for their prey but snap up, with a quick jerk of the head, the minnows that come near the surface



Sharks glide stealthily from one cut to another in the outer coral reef, seeking such finny residents as they may devour. As we rowed in to the island, they nipped at our oar blades, nosing curiously the strange disturber of their unfrequented waters

During the winter months Laysan suffers from violent storms. The waves pile across the reefs with thunderous roars, rushing in and breaking over the south sea wall in clouds of spray, often sixty feet high. The greens and dark blues of the deep water meet sharply the light blue of the water over the reefs, and these, together with the prismatic colors of the spray, contrast with the dark and forbidding shadows of the broken bowlders of the reef



The sea wall is cut up with innumerable potholes in which live queer goby fish which leap from one hole to another to make their escape from pursuing enemies. Spined sea urchins line the most exposed places where they receive the full force of the breaking waves. The reefs have, however, other stories to tell for on them may be found many a bolt and hasp from wrecked ships, reminders of tragedies of days long past

which crashed against the bowlder-strewn wall, so we turned westward.

At sun-up next morning we sighted Necker Island, a distant, ghostly mass showing vaguely against the sky line. This wall of igneous rock, picturesque and forbidding with its red veins showing against the dark, is a little more than half a mile in length and three hundred feet in height. The walls are precipitous and only in the calmest weather is it possible to land a boat among the broken pinnacles. We pulled close to the island in a skiff, with sailors and a lieutenant to man the boat, but, although we rounded the northernmost point searching for a landing, the crashing waves kept us from a near approach. Sharks nipped at the oar blades and as we entered the deep shadow of the high wall, a great skate rose off our bow—an indistinct mass of glowing phosphorescence, and then sank slowly from view.

It is majestic in the lee of that island. Thousands of birds shriek above one's head, and the sight and sound of the waves, with their high-thrown spray, are bewildering. One of our party landed by swimming—a hazardous feat—and obtained a footing on the slippery rocks only after he had three times disappeared under water, sucked down by the undertow. This rocky islet, far from the main Hawaiian group, is noted for the old stone monuments built upon its crest. Numerous little idols have been found and it is supposed that the ancient Hawaiians used Necker as a place of worship—a long voyage for their small outrigger canoes, with no compass to guide them!

Pearl and Hermes reefs with the rare warm-water seal, Midway Island, the farthermost of the chain, and Lisiansky were visited, all of interest for their wealth of birds. But it was on Laysan that we spent three months, studying the conditions of this Pacific reservation.

Laysan is apart from the world. It is 850 miles from Honolulu, and so far off the general line of boat travel that during our entire stay we saw not even the smoke of a distant vessel. The island is oval in shape, two miles in length by one in width, a dazzling strip of sand lost in the sparkling Pacific—just a dot of white upon the broad expanse. It is supposed to be a raised atoll, and the interior area slopes gently to a little salt lagoon, bordered with a thick carpet of *Portulaca*.

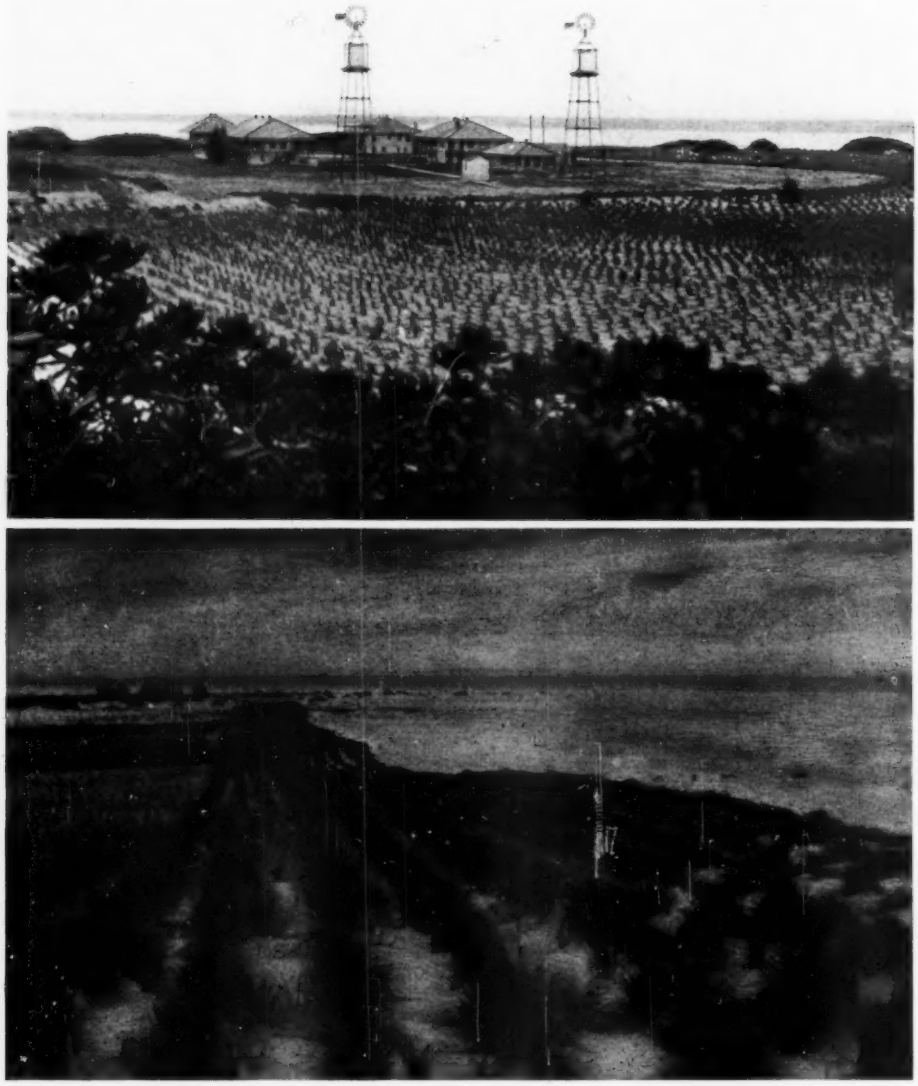
This island is the largest of the Leeward reservation and the best known to bird lovers the world over. Here on this little place are found five species of indigenous birds, one the Laysan teal so restricted in numbers that only seven individuals existed at the time of our visit; a wingless rail skulks among the grasses, the red honey-eaters, quiet-colored miller birds, and joyous-voiced finches dart among the *Chenopodium*. But to the casual observer the vast throngs of sea birds that crowd this sanctuary make it a delight. A great colony of Laysan albatrosses occupies the flat surrounding the lagoon, where they assemble each year to raise their young. A great flock of these large white birds of immaculate plumage resembles the whitest of cotton fields, and hundreds of these darting albatrosses in the sunlight give a picture beyond the power of camera or artist to portray. On the exposed beaches, where the winds sweep viciously, are reared the young of the black-footed albatrosses. These old pirates have a rugged disposition and are inclined to make a stand for their rights, fighting off intruders with beak and wing.

Five species of agile terns make Laysan their nesting ground, and when large numbers of graybacks and sooties are assembled, it is necessary for a man to shout if he cares to be heard above the calls of the birds. The large noddy and its smaller brother, the Hawaiian tern, choose the matted bushes as nesting sites, and often ten nests may be

THE LITTLE WHITE TERN OF THE PACIFIC

The little white tern (*Gygis alba kittlitzi*), or the "love bird" of the Pacific, is not common on Laysan, for it has been mercilessly slaughtered by poachers. Only three pairs of the terns were nesting on Laysan at the time of our arrival and one little brown chick hatched out the first day. Two months later he was flying about in company with his parents. This species lays only one egg, usually on an exposed rock with no nest whatever, but occasionally the egg may be found balanced precariously on a bare branch. Whenever an intruder wanders near the brooding birds they flutter about examining him curiously. As the birds hover overhead their dark eyes seem all out of proportion in size, and their rather harsh monotonous voice inappropriate for such delicate creatures. The young cling tenaciously to the nest, and the parent feeds them with small silvery fishes which she carries crosswise in her beak, two or more at a time.

The safety of this species seems assured, notwithstanding the persecution on Laysan, for the birds are found by thousands on Necker, French Frigate Rock, and Bird Island, where they nest among the inaccessible cliffs.



Successful experiments have been conducted on sandy wastes in the Pacific in the transplantation of a species of salt grass from California. The time has now come to reclaim the slopes of Laysan Island because of the ravages of a rapidly multiplying rabbit horde. The rabbits, which were introduced about 1903, are destroying the vegetation and will turn the already inhospitable island into a desert unless they can soon be reduced. It will be difficult, however, to exterminate the pests owing to the presence of thousands of petrel and shearwater burrows which afford safe hiding

found to the square yard. But the little white tern, the "Love Bird of the Pacific," is the most beautiful of all, white of plumage with an indescribable flush given by the salmon color which veins the tail and wing feathers, and with deep-set black eyes and glossy beak. As they poise a few feet overhead, white against the light sky, they are the most interesting studies in light and shade imaginable. They lay a single egg on an exposed rock, although I saw one egg deposited on the limb of a bush in a depression scarcely larger around than

The man-o'-war bird rises from the nest awkwardly, sprawling over the bushes, but once on the wing he is a powerful flier, soaring to great heights in an almost total calm. The immature birds (recognized in the photograph by the white feathers of the head) are playful and dart at the visitor with open mouth, but although very formidable-looking they can inflict no injury

On Laysan the man-o'-war birds build their nests among the bushes, using a miscellaneous heap of sticks and vines. They build several weeks before the time to lay the eggs, and spend the intervening days holding down their claims, for such is the competition in the matter of space and nesting materials that if they leave the nest unguarded it is soon appropriated, as a whole or piecemeal, by neighbors. (See appearance of the inflated gular pouch when the bird is in flight, page 382)

the egg itself. The tiny brown chicks are protectively colored and cling tenaciously to the rocks.

Petrels and shearwaters crowd the island, nesting in deep burrows dug in the loose coral sand. The white-breasted petrel is a dove-like bird which seems literally to swarm over the island in the evening. The air was so filled with flying birds that we always had to protect our faces when near their nesting colonies, and they were continually coming into the house at night, attracted by the light. ChristmasIsland shearwaters nest under the bushes, while the quarrelsome wedge-tails go far underground. Great colonies of the long-winged man-o'-war birds nest on the heights of the southern end of the island. Flocks of these birds will sail for hours; higher and higher they go, as we watch, until they gradually disappear from view. The solemn-looking blue-faced booby and the smaller, more graceful red-footed booby nest in near proximity to these man-o'-war birds and make a welcome addition to the old frigate's domain. It is common to see one of these beautiful white birds go squawking through the air, closely pursued by several old man-o'-war birds. If the booby is heavily laden with fish, he is soon overtaken, and if he does not disgorge gracefully, the man-o'-war usually grabs him by the tail and turns him completely over, thus persuading him. His resource is to alight as quickly as possible, for his long-winged enemy is helpless on the ground.

The black-footed albatross (*Diomedea nigripes*) is especially a bird of grace and power, a wanderer on the high seas for most of the year, but in season a careful attendant upon domestic duties. In the presence of a human visitor the parent takes great pride in her offspring, but stands ready to resent any undue familiarity. With the offspring of her neighbors, however, the parent albatross shows impatience, and not infrequently trounces all undefended nestlings in the vicinity. The young birds when approached by the visitor become excited, snap their bills, and may even attempt to charge

Laysan, on our visit, was still a bird paradise, and this in spite of the fact that a few years previous it had been raided by poachers who killed, it is estimated, at least 180,000 birds. We judged that during our stay there were present about 50,000 albatrosses, 50,000 pairs of petrels, half as many terns, and a few odd thousands of other species. There were not many more birds on Laysan at that time than the poachers had killed. At the Waikiki dumping grounds in Honolulu

we destroyed eleven wagonloads of the feathers and wings which had been collected by the poachers, besides a whole shedful left on Laysan when the revenue cutter "Thetis" took off the poachers with their plunder. I will not go into detail about the barbarous methods used in the slaughter, cutting off the wings and allowing the birds to die of hemorrhage, and other equally savage practices.

When we were on the island, even though the birds had been so terribly persecuted such a short time before, they were responding to the renewed favorable conditions; and now they will soon replenish their devastated colonies if adequate precaution is taken to prevent another raid. Before the war the island was protected by the revenue cutter which made several trips a year into those waters, which proved often enough to prevent a well-established raid. The poachers were on Laysan at the time the island was made into a reservation, and their plundering was well along before the officers had the authority to interrupt the ravages. Because of late the war has interfered with our work of protection, advantage may be taken of our unpreparedness, and another raid, more serious than the first, is perhaps to be feared.

But Laysan's worst enemy is within her own borders, and if relief is not offered soon, the island will become a waste of drifting sand. Rabbits were introduced a good many years ago and have increased to such an extent that they now overrun the island. The vegetation is being depleted so rapidly by them that there is danger the little indigenous birds will perish. The bushes, which once offered favorable nesting sites, are girdled, the bunch grass undermined and destroyed. Even the trailing vines are disappearing, and the loose coral sand, no longer anchored by a network of roots, shifts in great clouds at every turn of the wind. The sea birds could go elsewhere, of course, but their inherited tendency to return year after year is strong, and their young perish in uncountable numbers. The winds start the sands drifting, and the young birds are smothered under the forming dunes. Young albatrosses start toddling with the swift-moving sea of sand, become exhausted, and are soon covered over. The little petrels, nesting underground, are the most terribly punished. I have found them where they had worked their way to the surface of their filled burrows and, unable to go farther, had died with their heads just above ground, buried alive,—and not one or two, but thousands.

We killed more than five thousand rabbits by actual count, and that should be a help, but by now the pests will be as numerous as ever, and it is strongly recommended that something systematic be done to lessen their numbers, and something also to increase the vegetation. There is a tobacco which has in some way been introduced on the island; this seems to be increasing in abundance. But the tussock grasses, so necessary to hold the soil to the inner slope, the *Chenopodium*, and various bushes are fast disappearing. Rapid-growing forms which will hold the sand should be introduced,—the good work of reclaiming the waste land of Midway is proof that the work can be done, but it should not be delayed.

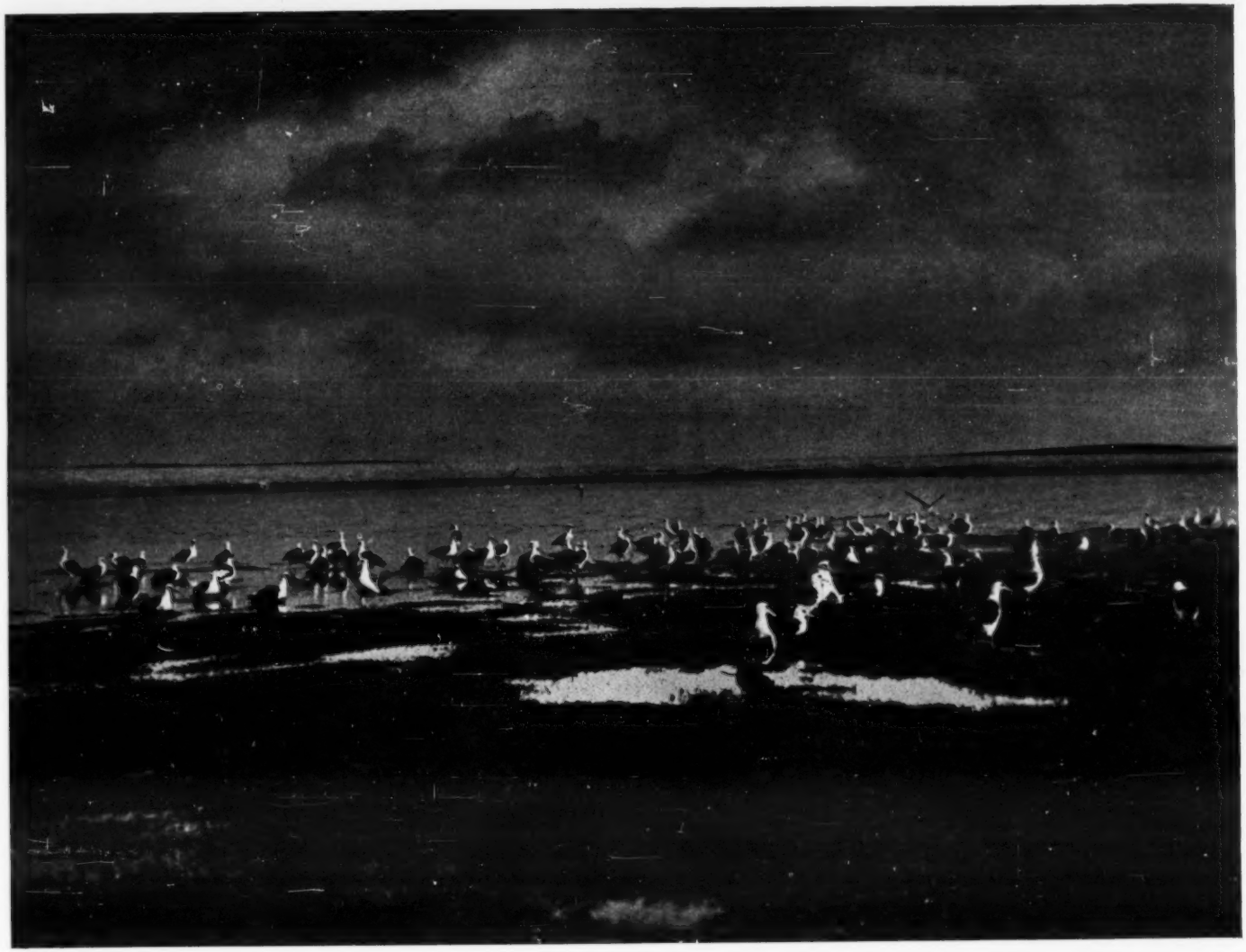
The late Theodore Roosevelt established that great Hawaiian reservation in 1909, along with many others in this country. Roosevelt is gone now, and his many friends and admirers are seeking to establish monuments to perpetuate his memory. A Roosevelt Foundation for the Protection of Wild Life would be a fitting memorial and would meet many such emergencies as that of Laysan.

BLACK-FOOTED ALBATROSSES NEST ON THE SAND OF THE SEA BEACH

The black-footed albatross (*Diomedea nigripes*) is the species most commonly seen at sea in the north Pacific. These birds are more graceful than the Laysan albatross—and have natures much more irascible. They scoop out their nests on the exposed beaches where the winds sweep violently. It is a common thing to see them sitting on their nests all facing into the wind. Both parents help in the work of incubation, while one is on the nest the other is out at sea catching squids, and they seem to take joy in their housekeeping

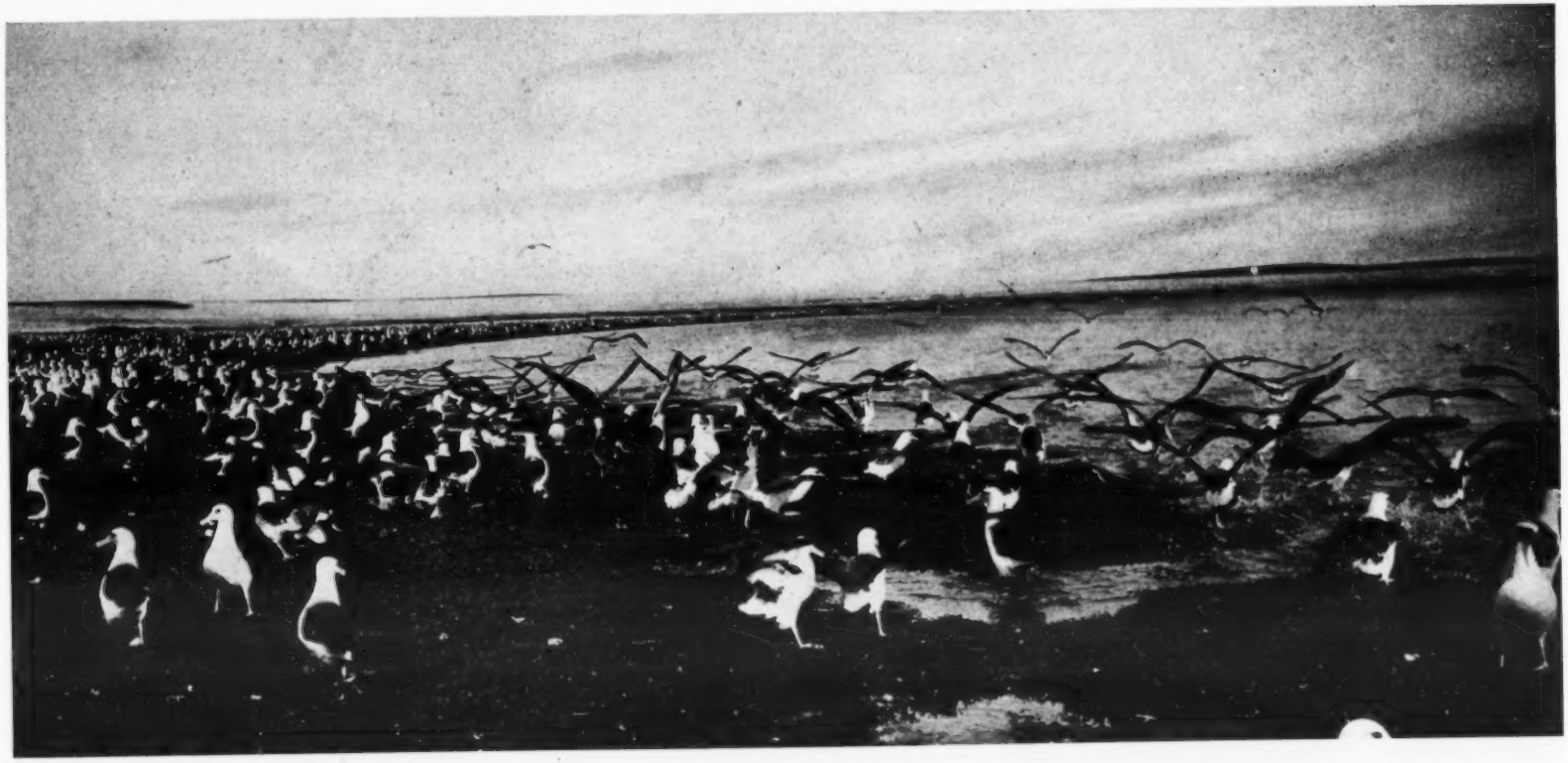
THE ALBATROSSES BUILD DIKES AGAINST THE FLOODS

The white albatross does scarcely any nest bui'ding, but as the bird incubates the single egg she gradually scoops a levee about her, using mud and grass and scattered fish bones in the masonry. These levees often stand the Laysan albatross in good stead for it chooses the gentle slopes and the flats bordering the salt lagoon in the center of the island as the place to rear its young. As the island is saucer-shaped with a high ridge around the edge, the excessive rains often cause floods over large areas. The birds obstinately continue incubating, even when the water is so deep that they are nearly floated away, and it is surprising how much dampness the eggs will stand without becoming spoiled. Thousands of eggs are necessarily abandoned each year, much to the enjoyment of the bristle-thighed curlew who grows fat on the plunder



ON THE MARGIN OF THE CENTRAL LAGOON

Of the two species of albatrosses on the island the Laysan (*Diomedea immutabilis*) is by far more numerous. Probably twenty-five thousand of the long-winged wanderers were busily attending to home duties during our visit, and thousands of young were raised, thus helping to fill the void caused by the ravages of poachers. The albatrosses spend the greater part of the year on the high seas, seldom frequenting land, but they assemble from the sea in the late fall for the nesting season, the first eggs being deposited the latter part of November



THE ALBATROSS REQUIRES A RUNNING START

Albatrosses are great fliers and remain on the wing for hours at a time but they find difficulty in taking-off from either land or water, and run into the wind for some distance before rising. Their flying consists for the most part of soaring or sailing with or against the wind and they are able to quarter a breeze only with great difficulty. These birds while away long hours on the island dancing, each bird striving to out-do the others in making noise as well as in assuming grotesque postures (see photographs of dancing albatrosses, AMERICAN MUSEUM JOURNAL for April, 1913, "The Albatrosses of Laysan")

Frontispiece engraved for Sir William Jardine's London edition of "American Ornithology," 1832

ALEXANDER WILSON, ONE OF AMERICA'S GREAT HUNTER-NATURALISTS (1766-1813)

Inspired by the story of the life of Alexander Wilson, a Kentucky boy of today has searched until weary alone through the woods to find the Kentucky warbler, a bird discovered and named by Wilson which James Lane Allen makes typify the boy's self. The boy dreams:

. . . Then there stepped forth into the open the figure of a hunter, lean, vigorous, tall, athletic. . . . He discovered Webster and with a look of relief stood still and smiled. There could be no mistake. Webster held imprinted on memory from a picture those features, those all-seeing eyes; it was Wilson —weaver lad of Paisley, wandering peddler youth of the grey Scotch mountains, violinist, flutist, the poet who had burned his poem standing in the public cross, the exile, the school teacher for whom the boy caught the mouse, the failure who sent the drawing to Thomas Jefferson, the bold figure in the skiff drifting down the Ohio—the naturalist plunging into the Kentucky wilderness and walking to Lexington and shivering in White's garret—the great American ornithologist, the immortal man.

. . . He came and stood before Webster and looked down at him with a smile:

"Have you found him, Webster?"

Webster strangely heard his own voice:

"I have not found him."

"You have looked long?"

"I have looked everywhere and I cannot find him." . . .

"Why do you look for the Kentucky Warbler?"

Webster hesitated long:

"I do not know," he faltered.

"Something in you makes you seek him, but you do not know what that something is?"

"No, I do not know what it is: I know I wish to find him."

"Not him alone but many other things?"

"Yes, many other things."

"The whole wild life of the forest?"

"Yes, all the wild things in the forest—and the wild forest itself."

There was silence. The forest was becoming more wonderful. The singing of the unseen birds more silvery sweet. It was beyond all reality.

. . . The hunter hurled questions now with no pity:

"Would you be afraid to stay here all night alone?"

"I would not."

"If, during the night, a storm should pass over the forest with thunder deafening you and lightning flashing close to your eyes and trees falling everywhere, you would fear for your life and that would be natural and wise; but would you come again?"

"I would."

"If it were winter and the forest were bowed deep with ice and snow and you were alone in it, having lost your way, would you cry enough! Would you hunt for a fireside and never return?"

"I would not."

"You can stand cold and hunger and danger and fatigue; can you be patient and can you be persevering?"

"I can."

"Look long and not find what you look for and still not give up?"

"I can."

There was silence for a little while: the mood of the hunter seemed to soften:

. . . *"Come,"* he said, as with high trust, *"I will show you the Kentucky warbler."*

Quoted from James Lane Allen's *The Kentucky Warbler*, pp. 164–70

Alexander Wilson

A LIFE THAT LED, THROUGH MANY YEARS OF DEFEAT, TO THE HIGH ADVENTURE OF PERSONAL SACRIFICE, PROFOUND ENDEAVOR, AND SUCCESS

Quoted through the courtesy of the Author and of Doubleday, Page & Company, publishers, from "The School," the second chapter of James Lane Allen's *The Kentucky Warbler*

FOREWORD.—The scene is a classroom in one of the high schools of Kentucky in 1916; an exchange professor is standing before the pupils ready to address them; the sunshine of an April morning enters at the windows, slanting across the faces of the pupils, and there is a sound in the air of distant bird song. Webster, the Kentucky boy whose vision of Wilson and the Kentucky warbler is told on the preceding page, is among the pupils, far back near a window, as though with a wish to jump out and be free.

The lecturer's subject is the life of Alexander Wilson, but first he tells of George Eliot's Silas Marner and his life as a weaver in Raveloe, England, for two reasons, to enforce the picture of Wilson as a poor Scotch weaver and to put emphasis on the great power of seeing which Wilson possessed in contrast with Silas Marner who saw only his thread and shuttle and loom. The following quotation is the story of Alexander Wilson, as the lecturer told it, and it is a great pleasure to be allowed to present it in the very beautiful prose of James Lane Allen, the author, carrying his keenness of understanding, his appreciation of both human nature and nature, and his sympathy.

"I AM going to speak to you boys about a boy who never reached high school. I want you to watch how that boy's life first seen in the distance through mist and snow and storm as a faint glimmering spark, rudely blown upon by the winds of misfortune, endangered and all but ready to go out—I want you to watch how that endangered spark of a boy's life slowly begins to brighten in the distance, to grow stronger, and finally to draw nearer and nearer until at last it shines as a great light about you here in this very place. Watch, I say, how a troubled ray, low on life's horizon, at last becomes a star in the world of men, high fixed and resplendent—to be seen by human eyes as long as there shall be human eyes to see anything. . . .

"Now, about the period that George Eliot paints the life of her poor English weaver there lived, not in merry England but in Bonnie Scotland—and to be bonnie is not to be merry—there lived in the little town of Paisley, in the west of Scotland, a man by the name of Alexander Wilson, a poor illiterate distiller. He had a son—the boy I am to tell you about.

". . . The boy's father and mother opened before him the two main honoured roads of Scottish life [that of a physician and that of a minister] and bade him choose. He chose neither, for he was self-willed and wavering, and did not know his own mind or his own wish. He did know that he would not take the roads his parents pointed out; as to them he was a roadless boy.

"His mother died when he was quite young, a stepmother stepped into a stepmother's place, and she quickly decided with Scotch thrift. A third Scottish road should be opened to the boy and into that he should be pushed and made to go: he must be put to trade. Accordingly, when he was about eleven years old, he was taken from school and bound as an apprentice to a weaver; we lament child labour now: it is an old lament.

"The boy hated weaving as, perhaps, he never hated anything else in his life and in time he hated much and he hated many things. He seems soon to have become known as the lazy weaver. Years afterward he put into bitter words a description of the weaver: 'A weaver is a poor, emaciated, helpless being, shivering over rotten yarn and groaning over his empty flour barrel.' Elsewhere he called the weaver a scare-

crow in rags. He wrote a poem entitled *Groans from the Loom*.

"Five interminable years of those groans and all his eager, wild, headstrong, liberty-loving boyhood was ended: gone from him as he sat like a boy-spider with a thread passing endlessly into a web. During these interminable years, whenever he lifted his eyes from his loom and looked ahead, he could see nothing but penury and dependence and loneliness—his loom to the end of his life.

"Five years of this imprisonment and then he was eighteen and his own master; and the first thing he did was to descend from the loom, take a pack of cloth upon his shoulders and go wandering away among the hills and valleys and lakes of Scotland—free at last like a young deer in the heather. He said of himself that from that hour when his eyes had first opened on the light of grey Scotch mountains, the world of nature had called him. He did not yet know what the forest and the life of the forest meant or would ever mean; he only knew that there he was happy and at home.

"Thus, like Silas Marner, he became a poor weaver and peddler but not with Silas Marner's eyes. Seldom in any human head has the mechanism of vision been driven by a mind with such power and eagerness to observe. And he had the special memory of the eye. There are those of us who have the special memory of the ear or of taste or of touch. He had the long, faithful recollection of things seen. With this pair of eyes during the next several years he traversed on foot three-fourths of Scotland. . . .

"But though he followed one after another well nigh all the roads of Scotland, he could find in all Scotland no road of life for him. It is true that certain misleading paths beckoned to him, as is apt to be true in every life. Thus he had conceived a great desire to weave poetry instead of cloth, to weave music instead of listening to the noise of the loom: he had his flute and his violin. But what he accomplished with poetry and flute and violin were obstacles to his necessary work and rendered this harder. The time he gave to them made his work less: the less his work, the less his living; the less his living, the more his troubles and hardships.

"Robert Burns was just then the idolised poet of Scotland, a new sun shining with vital splendour into all Scottish hearts. Friends of the young weaver and apparently the young weaver himself thought there was room in Scotland for another Burns. Some of his poems were published anonymously and the authorship was attributed to Burns. That was bad for him, it made bad worse. Wilson greatly desired to know the rustic poet-king of Scotland. The two poets met in Edinburgh and were to become friends. Then Burns published *Tam O'Shanter*.

"The Paisley weaver by this time had such conceit of himself as a poet that he wrote Burns a caustic letter, telling him the kind of poem *Tam O'Shanter* should and should not be. Burns replied, closing the correspondence, ending the brief friendship and leaving the weaver to go back to his loom. It was a terrible rebuff, and left its mark on an already discouraged man.

"Next Wilson wrote an anonymous poem, so violently attacking a wealthy manufacturer on behalf of his poor brother weavers, that the enraged merchant demanded the name of the writer and had him put in prison and compelled him to stand in the public cross of Paisley and burn his poem.

"Darker, bitterer days followed. He shrank away to a little village even more obscure than his birthplace. There, lifting his eyes, again he looked all over Scotland: he saw the wrongs and sufferings of the poor, the luxury and oppression of the rich: he blamed the British government for evils inher-

ent in human nature and for the imperfections of all human society: turned against his native country and at heart found himself without a fatherland.

"Then that glorious vision which has opened before so many men in their despair, disclosed itself: his eyes turned to America. . . . In America he thought all roads were open, new roads were being made for human lives; that should become his country. One autumn he saw in a newspaper an advertisement that an American merchantman would sail from Belfast the following spring and he turned to weaving and wove as never before to earn his passage money. At this time he lived on one shilling a week! . . . When spring came, with the earnings of his loom he walked across Scotland to the nearest port. When he reached Belfast every berth on the vessel had been taken: he asked to be allowed to sleep on the deck and was accepted as a passenger.

". . . The port was to be Philadelphia but he seems to have been so impatient to set foot on the soil of the New World that he left the ship at New Castle, Delaware. He had borrowed from a fellow-passenger sufficient money to pay his expenses while walking to Philadelphia thirty-four miles away; and with this in his pocket and his fowling-piece on his shoulder he disappeared in the July forests of New Jersey. The first thing he did was to kill a red-headed wood-pecker which he declared to be the most beautiful bird he had ever seen.

"I do not find any word of his that he had ever killed a bird in Scotland during all his years of wandering. Now the first event that befell him in the New World was to go straight to the American woods and kill what he declared to be the most beautiful bird he had ever seen. This might naturally have been to him a sign of his life-road. But he still stood blinded in his path, with not a plan, not an idea, of what he should be or could be: he had not yet read the handwriting on the wall within himself.

"His first years in the New World were more disastrous than any in Scotland, for always now he had the loneliness and dejection of a man who has rejected his own country and does not know that any other country will accept him. A fellow Scot, in Philadelphia, tried him at copper-plate printing. He quickly dropped this and went back to the old dreadful work of weaving—he became an American weaver and went wandering through the forests of New Jersey as a peddler: at least peddling left him free to roam the forests. Next he tried teaching but he himself had been taken from school at the age of eleven and must prepare himself as one of his own beginners. He did not like this teaching experiment in New Jersey and migrated to Virginia. Virginia did not please him and he remigrated to Pennsylvania. There he tried one school after another in various places and finally settled on the outskirts of Philadelphia: here was his last school, for here was the turning point of his life.

"I wish I had time to describe for you the school-house with its surroundings, for the place is to us now a picture in the early American life of a great man—all such historic pictures are invaluable. Catch one glimpse of it: a neat stone school-house on a sloping green; with grey old white oaks growing around and rows of stripling poplars and scattered cedar trees. A road ran near and not far away was a little yellow-faced cottage where he lived. The yard was walled off from the road and there were seats within and rose-bushes and plum trees and hop-vines. On one side hung a sign-board waving before a little roadside inn; on the other a blacksmith shop with its hammering. Not far off stood the edge of the great forest 'resounding with the songs of warblers.' In the depths of it

was a favourite spot—a secret retreat for him in Nature.

"There then you see him: no longer a youth but still young; every road he had tried closed to him in America as in Scotland: not a doctor, not a minister, not a good poet, not a good flutist, not a good violinist, not a copper-plate engraver, not a willing weaver, not a willing peddler, not a willing school-teacher—none of these. No idea yet in him that he could ever be anything. A homeless self-exile, playing at lonely twilights on flute and violin the loved airs of rejected Scotland.

"Now it happened that near his school was a botanical garden owned by an American naturalist. The American, seeing the stranger cast down by his aimless life, offered him his portfolio of drawings and suggested that he try to draw a landscape, draw the human figure. The Scotch weaver, the American school-teacher, tried and disastrously failed. As a final chance the American suggested that he try to draw a bird. He did try: he drew a bird. He drew again. He drew again and again. He kept on drawing. Nothing could keep him from drawing. And there at last the miracle of power and genius, so long restless in him and driving him aimlessly from one wrong thing to another wrong thing, disclosed itself as dwelling within his eyes and hands. His drawings were so true to life, that there could be no doubt: the road lay straight before him and ran clear through coming time toward eternal fame.[1]

"All the experience which he had been unconsciously storing as a peddler in Scotland now came back to him as guiding knowledge. The marvelous memory of his eye furnished its discipline: from early boyhood through sheer love he had unconsciously been studying birds in nature, and thus during all these wretched years had been laying up as a youth the foundation of his lifework as a man.

"Genius builds with lavish magnificence and inconceivable swiftness; and hardly had he succeeded with his first drawings before he had wrought out a monumental plan: to turn himself free as soon as possible into the vast, untravelled forest of the North American continent and draw and paint its birds. Other men, he said, would have to found the cities of the New World and open up its country. His study was to be the lineaments of the owl and the plumage of the lark: he had cast in his lot with Nature's green magnificence untouched by man. . . .

"For a while he must keep on teaching in order to live: he taught all day, often after night, barely had time to swallow his meals, at the end of one term tells us he had as large a sum as fifteen dollars. Often he coloured his first drawings by candle light, drew and painted birds without knowing what they were. Drawing and painting by candle light!—but now he had within himself the risen sun of a splendid enthusiasm. That sun kindled his school-boys. They found out what he wanted and helped. One boy brought him a large basketful of crows. Another caught a mouse in school and contributed that—the incident is worth quoting by showing that the boy preferred a mouse to a school-book.

"Take one instance of the energy with which he was now working and worked for the rest of his life: he wished to see Niagara Falls, and to lose no time while doing it he started out one autumn through the forest to walk to the Falls and back, a short trip for him of over twelve hundred miles. He reached home 'mid the deep snows of winter with no soles to his boots. What of that? On his way back he had shot two strange birds in the valley of the Hudson! For ten days—ten days, mind you!—he worked on a drawing of these and sent it with a letter to Thomas Jefferson. You may as yet have thought of Jefferson only as

[1] The naturalist was William Bartram. Wilson wrote to him in 1805, "They [his bird drawings] may yet tell posterity that I was honored with your friendship, and that to your inspiration they owe their existence."

one of America's earliest statesmen: begin now to think of him as one of the first American naturalists. And if you wish to read a courteous letter[1] from an American President to a young stranger, go back to Jefferson's letter to the Scotch weaver who sent him the drawing of a jaybird.

"Pass rapidly over the next few years. He has made one trip from Maine down the Atlantic Seaboard to the South. He has returned and is starting out again to cover the vast interior basin of the Mississippi Valley: he is to begin at Pittsburgh and end at New Orleans.

"Now you see that he is coming nearer—nearer to you here.

". . . It is the twenty-fourth of February: the river, swollen with the spring flood, is full of white masses of moving ice. . . . They warned him of his danger, urged him to take a rower, urged him not to go at all. Those who risked the passage of the river floated down on barges called Kentucky arks or in canoes hollowed each out of a single tree, usually the tulip tree, which you know is very common in our Kentucky woods. But to mention danger was to make him go to meet it. He would have no rower, had no money to hire one, had he wished one. He tells us what he had on board: in one end of the boat some biscuit and cheese, a bottle of cordial given him by a gentleman in Pittsburgh, his gun and trunk and overcoat; at the other end himself and his oars and a tin with which to bail out the skiff, if necessary, to keep it from sinking and also to use as his drinking-cup to dip from the river.

"That February day—the swollen, rushing river, the masses of white ice—the solitary young boatman borne away to a new world on his great work: his heart expanding with excitement and joy as he headed toward the unexplored wilderness of the Mississippi Valley.

"Wondrous experiences were his: from the densely wooded shores there would reach him as he drifted down, the whistle of the red bird—those first spring notes so familiar and so welcome to us on mild days toward the last of February. Away off in dim forest valleys, between bold headlands, he saw the rising smoke of sugar camps. At other openings on the landscape grotesque log cabins looked like dog-houses under impending mighty mountains. His rapidly steered skiff passed flotillas of Kentucky arks heavily making their way southward, transporting men and women and children—the moving pioneers of the young nation: the first river merchant-marine of the new world; carrying horses and plows to clearings yet to be made for homesteads in the wilderness; transporting mill-stones for mills not yet built on any wilderness stream. . . .

"He records what to us now sounds incredible, that on March fifth he saw a flock of parrakeets. Think of parrakeets on the Ohio River in March! . . . Once he encountered a storm of wind and hail and snow and rain, during which the river foamed and rolled like the sea and he had to make good use of his tin to keep the skiff bailed out till he could put in to shore. The call of wild turkeys enticed him now toward the shore of Indiana, now toward the shore of Kentucky, but before he reached either they had disappeared. His first night on the Kentucky shore he spent in the cabin of a squatter and heard him tell tales of bear-treeing and wildcat-hunting and wolf-baiting. All night wolves howled in the forests near by and kept the dogs in an uproar; the region swarmed with wolves and wildcats 'black and brown.'

"On and on, until at last the skiff reached the rapids of the Ohio at Louisville and he stepped ashore and sold his frail saviour craft which, at start-

[1] This letter is given in full in Vol. I, pp. liii–liii, 1828 edition of *American Ornithology; or Natural History of the Birds of the United States.* By Alexander Wilson.

ing, he had named the Ornithologist. The Kentuckian who bought it as the Ornithologist accepted the droll name as that of some Indian chief. He soon left Louisville, having sent his baggage on by wagon, and plunged into the Kentucky forest on his way to Lexington.

"And now, indeed, you see he is coming nearer.

"It was the twenty-fourth of March when he began his first trip southward through the woods of Kentucky. Spring was on the way but had not yet passed northward. Nine-tenths of the Kentucky soil, he states, was then unbroken wilderness. . . .

"It was on March twenty-ninth that, emerging from the thick forest, he saw before him the little Western metropolis of the pioneers, the city of the forefathers of many of us here today—Lexington. I wish I could stop to describe to you the picture as he painted it: the town stretching along its low valley; a stream running through the valley and turning several mills—water mills in Lexington a hundred years ago! In the market-place which you now call Cheapside he saw the pillory and the stocks and he noted that the stocks were so arranged as to be serviceable for gallows: our Kentucky forefathers arranged that they should be conveniently hanged, if they deserved it, as a public spectacle of warning.

"On a country court day he saw a thousand horses hitched around the courthouse square and in churchyards and in graveyards. He states that even then Kentucky horses were the most remarkable in the world. . . .

"He slept while in Lexington—this great unknown man—in a garret called Salter White's, wherever that was: and he shivered with cold, for you know we can have chill nights in April. He says that he had no firewood, it being scarce, the universal forest of firewood being half a mile away: this was like going hungry in a loft over a full baker-shop.

"And I must not omit one note of his on the Kentuckians themselves, which flashes a vivid historic light on their character. By this time he rightly considered that he had had adventures worth relating; but he declares that if he attempted to relate them to any Kentuckian, the Kentuckian at once interrupted him and insisted upon relating his own adventures as better worth while. Western civilization was of itself the one absorbing adventure to every man who had had his share in it.

"On the fourteenth day of April he departed from Lexington, moving southward through the forest to New Orleans. Scarcely yet had the woods begun to turn green. . . .

"And now we begin to take leave of him: he passes from our picture. We catch a glimpse of him at the Kentucky River, standing on the perpendicular cliffs of solid limestone, green with a great number of uncommon plants and flowers—we catch a glimpse of him standing there, watching bank swallows and listening to the faint music of the boat horns in the deep romantic valley below, where the Kentucky arks, passing on their way southward, turned the corners of the verdurous cliffs as the musical gondolas turn the corners of vine-hung Venice in the waters of the Adriatic.

"On and on southward; visiting a roosting-place of the passenger pigeon which was reported to him as forty miles long: he counted ninety nests in one beech tree. We see him emerging upon the Kentucky barrens which were covered with vegetation and open for the sweep of the eye.

Now, at last, he begins to meet the approach of spring in full tide: all Nature is bursting into leaf and blossom. No longer are the redbud and the dogwood and the sassafras conspicuous as its heralds. And now, overflowing the forest, advances the full-crested wave of bird-life up from the south, from the tropics. New and unknown species are everywhere before his eyes; their new

melodies are in his ears; he is busy drawing, colouring, naming them for his work.

"So he passes out of our picture: southward bound, encountering a cloud of parrakeets and pigeons, emerging from a cave with a handkerchief full of bats, swimming creeks, sleeping at night alone in the wilderness, his gun and pistol in his bosom. He vanishes from the forest scene, never from the memory of mankind.

"Let me tell you that he did not live to complete his work. Death overtook him, not a youth but still young. . . .

"I told you I was going to speak to you of a boy's life. I asked you to fix your eyes upon it as a far-off human spark, barely glimmering through mist and fog but slowly, as the years passed, getting stronger, growing brighter, always drawing nearer until it shone about you here as a great light and then passed on, leaving an eternal glory.

"I have done that.

"You saw a little fellow taken from school at about the age of eleven and put to hard work at weaving; now you see one of the world's great ornithologists, who had traversed some ten thousand miles of comparative wilderness—an imperishable figure, doing an imperishable deed. I love to think of him as being in the end what he most hated to be in the beginning—a weaver: he wove a vast, original tapestry of the bird-life of the American forest.

"As he passed southward from Lexington that distant April of 1810, encountering his first spring in the Ohio valley with its myriads of birds, somewhere he discovered a new and beautiful species of American wood warbler and gave it a local habitation and a name.

"He called it the Kentucky Warbler.

"And now, would you not like to see a picture of that mighty hunter who lived in the great days of the young American republic and crossed Kentucky in the great days of the pioneers? And would you not also like to see a picture of the exquisite and only bird that bears the name of our State—the Kentucky Warbler?"

He passed over to them a portrait engraving of Alexander Wilson in the dress of a gentleman of his time, his fowling-piece on his forearm.[1] And along with this he delivered to them a life-like, a singing portrait, of the warbler, painted by a great American animal painter and bird painter—Fuertes.

[1] See page 396.

It was not until the lecturer had progressed in his story to the point where Wilson came to America that Webster, back by the window of the classroom, was noticeably interested. Finally, however, his attention became so breathless that it filled the room and the other listeners were merely grouped around it as accessories; and the lecturer recognized that he was witnessing "that particular miracle in nature—the contexture of the generations—the living taking the meaning of their lives from the dead.[2] You stand before some all but forgotten mound of human ashes; before you is arrayed a band of youths unconsciously holding in their hands the unlighted torches of the future. You utter some word about the cold ashes and silently one of them walks forward to the ashes, lights his torch and goes his radiant way."

Webster, the Kentucky boy of the present, filled with all that Wilson had been made to mean to him, spent a whole day wandering in pasture and forest, and returned home at night with the fragrances and bird songs still about him and the heat of the sun still in his blood. Then he lived in the reality of his great dream and wandered through the woods with Alexander Wilson. When finally the Kentucky warbler was revealed to him, he turned to his guide gratefully to thank him, but—

"No one was near him. Webster saw the hunter on the edge of the thicket yards away; he stood looking back, his figure dim, fading. Webster, forgetful of the bird, cried out with quick pain:

"'Are you going away? Am I never to see you again?'

"The voice that reached him seemed scarcely a voice; it was more like an echo, close to his ear, of a voice lost forever:

"'*If you ever wish to see me, enter the forest of your own heart.*'"

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[2] The grave of Alexander Wilson is in the churchyard of Gloria Dieu (Old Swede's) Church, of Philadelphia.

THEIR FIRST VIEW OF THE PACIFIC, 1806

Memorial in Bronze to Lewis and Clark by Charles Keck, Sculptor, New York

Soon to be unveiled in Charlottesville, Virginia, the early home of Meriwether Lewis. They stand at gaze, with Sacajawea, the squaw guide, bending forward, intent on the vast expanse of the ocean revealed before them

Thomas Jefferson's Contributions to Natural History

HIS EFFORT SENT OUT THE LEWIS AND CLARK EXPLORING PARTY INTO THE UNKNOWN WEST—RECOGNITION AND HONOR ARE GIVEN TODAY TO THE EXPEDITION'S LEADER, MERIWETHER LEWIS

By JOHN S. PATTON

Librarian of the University of Virginia

THE fact that Thomas Jefferson's best service to mankind was political has limited the world's estimate of his greatness to one contribution of his useful life. That he was the preëminent statesman of his day as today he is the dominating influence surviving from the first years of the republic, was not owing to a predilection for politics but to his answering the need for a great constructive and safely guiding genius at the beginning of our independent national life. He rejoiced, instead, at the prospect of the studious life. His letters abound in expressions of his desire to retire from the arena in which he was the most notable figure. The one to Dupont de Nemours is often quoted: "Within a few days I retire to my family, my books and farms. . . . Nature intended me for the tranquil pursuits of science, by rendering them my supreme delight."

And by science he meant more than men do now. It included more than observed facts systematically classified and brought under general laws—he meant by it all that was connoted by the word *scientia* in the days of its widest acceptation. He was an eager student—going into every field open to him. It would not do to claim profound scholarship for him in all instances; his interests were too catholic, and limitations of time and opportunity so restrained him that the thoroughness of the specialist, often meticulous, was not within his reach. But he had a more or less scholarly acquaintance with mechanics, astronomy, meteorology, physics, civil engineering (mensuration, strength of materials), surgical anatomy, geology, zoölogy, botany, economic entomology, aëronautics, and palæontology.

While this list transcends in some instances the limits to which "science" is confined by present day definition and intrudes upon the domain of the industrial arts, it is far from embracing all that Jefferson would have included in the meaning of science, *scientia*, the derivative of all information and skill. *His* science enabled him to invent a plow, indeed *the* plow, to construct a barometer, a thermometer, a wind gage, a duplicating writing machine, and what not; to realize West Point for the nation and the National Observatory, to build the University of Virginia and inform it with a spirit and purpose hitherto disregarded.

The student who takes to the highways and byways of knowledge is sure to find wherever he penetrates that Mr. Jefferson has passed along before him with more or less careful observation. After twelve years of faithful, scholarly work in rediscovering and determining the truth of Latin and Celtic accent and rhythm and showing that our traditional rule of Latin pronunciation is at variance with the obvious usage of Latin verse, Professor Thomas Fitz-Hugh, of the University of Vir-

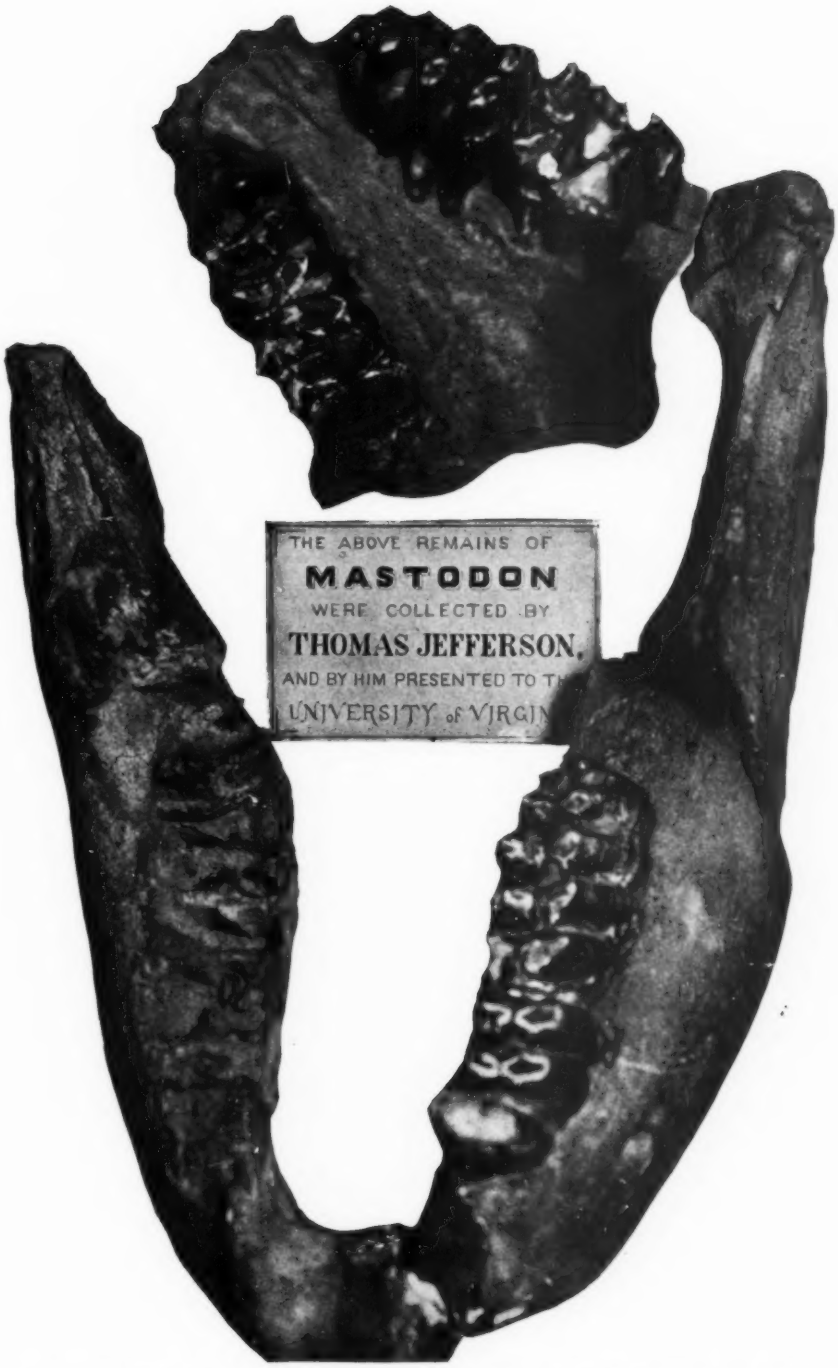
ginia, turned in pursuit of another object—for he had published the results of his own discovery—to Jefferson's essay, *Thoughts on English Prosody,* and found that he had been anticipated by Jefferson by more than a century, and that nobody had seemed to know it! While Jefferson was the first to assert and use the principle that the pronunciation of an ancient speech cannot contradict the known rhythm of its poetry, Fitz-Hugh has used the principle to reveal a new world of accent and rhythm in Latin and Celtic and to expose the error of the current theory in both fields. "It is well worth while," Professor Fitz-Hugh warns, "for the scholar and technical scientist of today to examine Jefferson's reflections upon any field of investigation in which he allows himself to make excursions."

And so Buffon thought long ago. He had announced his conviction that animals common to the Old and the New worlds are smaller in the latter, that those peculiar to America are smaller, that those domesticated in both have degenerated in the New world, and that the western world has fewer species. Mr. Jefferson collected data and upon ascertained facts based three tables in which he contrasted aboriginals (1) of both the Old and the New worlds, (2) of only one, and (3) of those domesticated in both. The first table showed that of twenty-six quadrupeds common to both America and Europe, seven are larger in America, seven of equal size, and as to twelve the facts were not decisive; the second showed that eighteen quadrupeds are peculiar to Europe and seventy-four to America, while one of the American quadrupeds—the tapir—weighs more than all the eighteen of Europe together; and the third failed to sustain Buffon's theory of animal degeneration in the New world. He did not stop here, but had the bones and skin of the largest moose obtainable, the horns of the caribou, elk, deer, spike-horned buck, and some other large animals sent to Paris. Buffon was convinced, and said to the Virginian: "I should have consulted you, Sir, before publishing my *Natural History,* and then I should have been sure of my facts." It is scarcely worth while to inquire whether the great Frenchman was pleased by the revelation of the truth or irritated by defeat.

In 1797 Jefferson was made president of the American Philosophical Society, and took his place officially at the head of the scientific world of his country. Elected Vice President of the United States, he went to Philadelphia to be inaugurated—and took with him the *os femoris,* a radius, an ulna, three claws, and some other bones of an animal then unknown to science, the giant edentate, allied to the recent sloth. These bones, which he had collected in Greenbrier County, Virginia, he presented to the Philosophical Society, with a statement of the results of his studies in connection with them. His discovery bears the name *Megalonyx jeffersonii.*

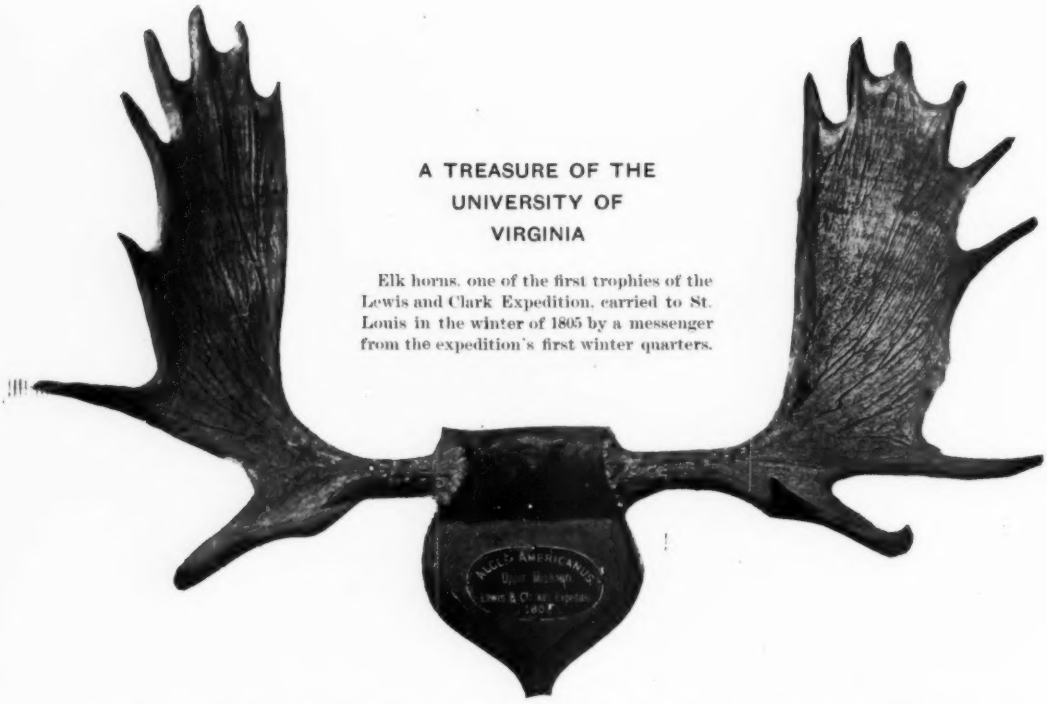
"The spectacle of an American statesman coming to take part as a central figure in the greatest political ceremony of our country and bringing with him an original contribution to the scientific knowledge of the world, is certainly one we shall not soon see repeated," said Frederic N. Luther, writing of Jefferson as a naturalist.[1] ". . . During those exciting weeks," Mr. Luther continued, "in February, 1801, when Congress was vainly trying to untangle the difficulties arising from the tie vote between Jefferson and Burr, when every politician at the capital was busy with schemes and counter-schemes, this man, whose political fate was balanced on a razor's edge, was corresponding with Dr. Wistar in regard to some bones of the mastodon which he had just procured from Shawangunk, Ulster County. Again in 1808, when the excitement

[1] *Magazine of American History* for April, 1885 (volume 13).



MASTODON JAWBONES COLLECTED BY JEFFERSON AT SHAWANGUNK, ULSTER COUNTY, NEW YORK

We have had two men in the presidential chair in the United States who were naturalists and who used their influence for the advance of scientific affairs—Thomas Jefferson and latterly Theodore Roosevelt. Of both these men the words by Jefferson, so often quoted, were true, "Nature intended me for the tranquil pursuits of science, by rendering them my supreme delight." That Jefferson received more blame than praise for his scientific work and that he is known in history only as a great statesman, but convinces us of the pioneer status of science a century ago and our greater enlightenment as to its value today (Regarding mastodon discoveries at Shawangunk, see note, page 496)



A TREASURE OF THE UNIVERSITY OF VIRGINIA

Elk horns, one of the first trophies of the Lewis and Clark Expedition, carried to St. Louis in the winter of 1805 by a messenger from the expedition's first winter quarters.

These elk horns were highly valued by Jefferson and were long at Monticello. The members of the Lewis and Clark Expedition, sent out as a direct result of Jefferson's interest in natural history and exploration, were the first white men to traverse the region now mapped as the states of Nebraska, North and South Dakota, Montana, Idaho, Washington, and Oregon. A memorial to Meriwether Lewis, leader of the expedition, is about to be inaugurated at Charlottesville, Virginia, his early home

over the embargo was highest, when every day brought fresh denunciations of him and his policy, he was carrying on his palæontological studies in the rooms of the White House itself. . . . Never for a moment, however apparently absorbed in other work, did he lose his warm sympathy with Nature." This devotion at that early time won for him less praise than ridicule and blame in his own country. The feeling it evoked was expressed by Bryant, then a boy of thirteen:

Go, wretch, resign the Presidential chair,
Disclose thy secret measures, foul or fair.
Go, search with curious eyes for horned frogs,
'Mid the wild wastes of Louisianian bogs;
Or, where the Ohio rolls his turbid stream,
Dig for huge bones, thy glory and thy theme.

The man thus lampooned was the author of *Notes on Virginia* which a historian of science, the late G. Brown Goode, of the Smithsonian Institution, declared "is the most important scientific work as yet published in America," if "measured by its influence." It was the first comprehensive account of the topography, natural history, and resources of any North American commonwealth, and Goode pronounced it "the precursor of the great library of scientific reports which have since been issued by the state and federal governments."

He was deeply interested in what was concealed from the world a century and a quarter ago in the great unexplored region between the United States and the western ocean. The mammoth, he believed, might be found roving the great interior plains; indeed, nothing was too much for his credulity. The exploration of the Northwest was one of his fixed purposes, to be carried out

at the first opportunity. When John Ledyard reached Paris in 1786, Jefferson, who was there as minister of the United States, believed the hour of the great adventure had arrived. Ledyard had been with Cook on his voyage to the Pacific and had engaged in other adventurous undertakings. He was appraised by Jefferson as "a man of genius" and "of some science," and the great American soon had him on the way to explore the western part of the North American continent. His itinerary was to take him through St. Petersburg to Kamchatka and thence to Nootka Sound. Ledyard's arrest by the Prussian government, which regarded the undertaking as impracticable, ended the enterprise, but not Jefferson's interest in it.

Six years later, in association with the American Philosophical Society, Mr. Jefferson, now Dr. Jefferson by the decrees of Yale and Harvard universities, promoted a subscription for the exploration of the West, and personally became responsible for a thousand guineas of the amount to be raised. André Michaux, the noted French botanist and traveler, and Meriwether Lewis, a youth of nineteen, who lived within ten miles of Jefferson's home in Albemarle County, Virginia, were chosen to make the westward journey. The letter of instructions, which was drawn with Jeffersonian care of details, discloses his interest in natural history. "Under the head of animal history," Michaux is told, "that of the mammoth is particularly recommended to your inquiries, as it is also to learn whether the Lama or Paca of Peru, is found in those parts of this continent." Whatever its motive, the French government interfered with the undertaking by charging Michaux with a mission relative to the occupation of Louisiana. Later the French minister canceled the appointment.

Ten years afterward Jefferson, then President of the United States, decided that the exploration ought not to be delayed longer. In 1803 the continuance of the act for establishing trading houses with the Indian tribes was under consideration and the President seized upon the opportunity it afforded to propose to Congress, in a confidential message, a party to explore the Missouri to its source and thence to make its way to the Pacific. ". . . other civilized nations have encountered great expense to enlarge the boundaries of knowledge by undertaking voyages of discovery, *and for other literary purposes,*" Mr. Jefferson contended. "The nation claiming the territory, regarding this as a literary pursuit,"—thus he advanced in his plan to persuade Congress—"would not be disposed to view it with jealousy." The necessary appropriation for the enterprise could be charged to "the purpose of extending the external commerce of the United States," which the President would understand as legislative sanction. The bill was passed.

Meriwether Lewis, who was to accompany Michaux, had now been for two years private secretary of President Jefferson, by whom he had been appointed captain of the first regiment of infantry, and was eager to undertake the adventurous journey. "Of courage undaunted," Mr. Jefferson wrote of him, "possessing a firmness and perseverance of purpose which nothing but impossibilities could divert from its direction, careful as a father of those committed to his charge, yet steady in the maintenance of order and discipline, intimate with the Indian character, customs, and principles; habituated to the hunting life, guarded by exact observation of the vegetables and animals of his own country against losing time in the description of objects already possessed; honest, disinterested, liberal, of sound understanding, and a fidelity to truth so scrupulous that

whatever he should report would be as certain as if seen by ourselves—with all these qualifications as if selected and implanted by nature in one body for this express purpose, I could have no hesitation in confiding the enterprise to him. To fill up the measure desired, he wanted nothing but a greater familiarity with the technical language of the natural sciences, and readiness in the astronomical observations necessary for the geography of his route. To acquire these he repaired immediately to Philadelphia, and placed himself under the tutorage of the distinguished professors of that place."

With Lewis Mr. Jefferson associated William Clark, a brother of George Rogers Clark, the Hannibal of the West,[1] and, like him, a born leader of men, a soldier and an expert in woodcraft and in knowledge of Indian character. The other members of the party were fourteen United States soldiers, nine volunteers, Clark's colored valet (York), and an interpreter and his Indian wife.

The Lewis and Clark Expedition was a high adventure with vast results, whose characterization transcends the scope of a sketch. An abundant and thrilling literature has resulted, and will be increased. The first installment of the story was written—as was appropriate—by Mr. Jefferson in his message "communicating discoveries made in exploring the Missouri, Red river, and Washita by Captains Lewis and Clark."

[1] George Rogers Clark, born in Virginia in 1752, won fame as soldier, surveyor, and Indian fighter. He was known as the conqueror of the large area northwest of the Ohio River, which was practically reclaimed from the warlike Indian tribes by him. He died in Kentucky February 18, 1818, and lies buried in an unmarked grave in Louisville.

While the record in books is ample, in marble and bronze it has been singularly scant, as in the case of Clark's elder brother, George Rogers Clark.

The members of the exploring party were the first white men to traverse the region now mapped as the states of Nebraska, North and South Dakota, Montana, Idaho, Washington and Oregon. Meriwether Lewis, the leader, who contributed to our knowledge of the customs, manners, and languages of the American Indians, has had until recently, so far as my information goes, a single visible memorial. In Lewis County, Tennessee, "in the midst of wild and romantic scenery, surrounded only by the native growth of the forest and where but few travelers pass, there stands a gray stone monument composed of native rock, with a shaft of limestone in imitation of a giant of the forest untimely broken," the tribute of the General Assembly of Tennessee rendered to Meriwether Lewis in 1848.[2]

Another memorial is now on the eve of inauguration in Charlottesville, Virginia, the home town of Lewis until he enlisted in the army at the time of the Pennsylvania whiskey insurrection. This monument, the work of Charles Keck, of New York, is a group in bronze, and commemorates the moment when Lewis and Clark had their first view of the Pacific. They stand at gaze, with Sacajawea, the squaw guide and only woman of the party, bending forward, intent on the scene. The group is the gift of Paul Goodloe McIntire, of Charlottesville.

[2] Since writing this I have been informed of a monument to Lewis and Clark in Portland, Oregon, but I have not been able to obtain facts relative to the artist or to the details of its erection.

War Impressions of French Bird Life

By LUDLOW GRISCOM

Member of the American Ornithologists' Union

APART from very obvious reasons for wanting to be in France during the war, the writer had long been interested in French bird life, owing to former extended travel in that country, so that there was the additional desire to renew acquaintance with old friends in the bird world, the hope of acquiring new ones, and the possibility of observing the effects of war upon them.

Conditions for Bird Life in France

The first fact about the birds of France that impresses the traveler is the small number of species in any given area, coupled with the extraordinary abundance of individuals of some species and the equally marked scarcity of others. This is easily accounted for. In a country settled as long as France has been, the adaptive power of any given species to a changing environment has been tested with merciless severity. It is obvious, therefore, that any species successfully passing this test has flourished in proportion, while the species that has failed must be sought for in game preserves, government forest lands, and such more remote sections of country as have remained comparatively unaltered through the centuries.

Another factor has served only to accentuate this process of elimination. In France, whether legally or otherwise, almost every bird is a game bird, or at least has been game during a very long past and up to very recently. It follows, therefore, that birds, although abundant, are remarkably shy in a great many cases. An interesting comparison can here be made with conditions in England, where the song thrush, blackbird, and robin redbreast are familiar garden birds dear to the hearts of the people. In France they are typical woodland birds, the two thrushes especially, so shy at times that they are about as easy to observe as a field mouse.

England has frequently been likened to a vast park. In the same spirit France could be likened to a huge wheat field or a vegetable garden neatly divided into little squares, hedges doing duty for fences. All western, northern, and central France is under a nearly maximum amount of cultivation, and the peasants cling each to his little patch of land with a passionate devotion which is a salient characteristic of the people. The bird lover, starting out from any given town in an effort to reach really good country, never gets there. All tempting patches of woodland in the distance turn out to be private parks with a high fence around them, or government *forêts,* at best second or third growth, all the trees planted at the same time, of equal height, and so close together as to be almost impenetrable, through which the peasants are constantly wandering, plucking the dead twigs from the shrubs and picking up windfalls in a pathetic effort to reduce their fuel expenses. So it is not surprising that hawks and woodpeckers, and the brightly colored birds are scarce, as well as all woodland species of retiring habits.

The scarcity of large rivers and the canalization of nearly all the smaller ones have made all water birds normally occurring inland very local. To make a broad statement, water birds are relatively much more abundant along the coasts than in the United States, and are scarcer inland. As regards land birds, they are most numerous specifically in southern France,

most abundant individually in western France, and scarcest in eastern France. The migration phenomenon is most marked along the coasts, and especially in the delta of the Rhone. Eastern France is much more broken in character, with a large proportion of woodland, and a much colder winter. As a result, many of the rarer local species occur here, so that a very fair list of summer residents can be obtained, without, however, any great number of individuals. Water birds are uniformly scarce even in migration. The winter bird life is relatively very poor.

The Birds of France and of America

While most of the families of birds in France are the same as in the United States, naturally enough the species are different. In fact, the little bank swallow has the unique distinction of being the only small land bird which is absolutely identical in the two continents. Even where the families are quite distinct, as the flycatchers and the oriole, there is often a surprising superficial resemblance in appearance and habits. One group, at least, of the European warblers, reminds one of our own puzzling *Vermivoras;* indeed, the chiffchaff could do duty very well as an orange-crowned warbler. In migration time mixed flocks of birds roam over the countryside just as in this country: kinglets, warblers, and titmice in the woods; buntings replacing sparrows in the fields, and swallows overhead. The wealth of species is, however, entirely lacking.

But the greatest outstanding impression is the difference in the relative representation of the same families of birds. The crow family is the best illustration. One can count on blue jays in the woods and crows in the fields almost anywhere in New York or New England. The European jay and the rook may appropriately be regarded as homologues. But magpies are absolutely everywhere, even in salt marshes and dunes along the seashore. In the fields the carrion crow occurs with the rook, while in winter the northern hooded crow with a gray mantle joins its cousins. Even so, I feel quite convinced that rooks alone are more numerous than crows in this country. An old castle, a cliff, or a cathedral spire is pretty sure to provide a home for a colony of jackdaws. Should the given locality include some high mountains, such as the Alps, it would be possible to add the raven, a chough and a nutcracker.

To those accustomed to our somber little chickadee, the European titmice furnish another surprise. Five species cannot be missed by the observer almost anywhere in France, while two others are possibilities. Among the five common ones some are by no means content with a staid and Quaker-like garb, and a blue, green, and yellow titmouse seems quite remarkable to American eyes, until extreme familiarity breeds contempt.

A third notable feature of the landscape is the abundance of the wood pigeon, a large blue-gray bird with conspicuous white wing patches—a true pigeon (*Columba*) with a short, square tail. Considering its conspicuousness and the fact that it must be good to eat, it is certainly amazing how it manages to exist in such numbers in so settled a country. Its wariness is one good reason at least, for out in the open country I have never been able to get within gunshot range of it. Where the chances for persecution are absolutely eliminated, however, it is quick to seize the opportunity; and today it is a common bird even in the smaller gardens of Paris, such as the Tuileries and the Parc Monceaux. In the late fall and early winter, especially in places where food is abundant, it gathers in large flocks, and a flight of several hundred birds streaming across the fields in the crispness of dawn is a very fine sight in the bird world.

A War Study of Birds in Eastern France

Circumstances prevented any indulgence of my hobby until I arrived at Chaumont, the American Great Headquarters, about September 1. The country here is a succession of steep hills, clad with evergreen and deciduous woods with open valleys between. The town is on the top of one of these long hills. To the south is open farm land, while, in the valley below, the infant Marne flows peacefully through green meadows. The buildings occupied by the Americans were at the end of a long boulevard bordered with trees, a few small gardens, and a park. Swallows and house martins flew up and down the streets. Chaffinches sang their simple trill in the park, and titmice of four kinds wandered through the gardens. In the pine woods on the slope of the hills were mixed flocks of titmice and kinglets. Creepers plodded patiently up the trunks, and tiny wrens for all the world like our winter wren, bobbed and scolded among the windfalls.

Down in the river valley itself, jays squawked and magpies chuckled. Rooks and carrion crows fed in the meadows; wood pigeons or stockdoves occasionally crossed high overhead, and over the hilltops soared the buzzard, screaming very much like our own red-shouldered hawk. The fishing rights of the river were amicably divided between a pair of dippers and some kingfishers, the latter a tiny feathered beauty, turquoise blue and chestnut, which darted up and down stream like nothing so much as a gigantic bumblebee, and gave sharp squeaks by way of relieving its feelings. The gray and the white wagtails, with long tails constantly going up and down, were permitted, however, to search for humbler food on the banks, while the sedge warbler nested peacefully in the rushes. In the shade trees along the canal the green woodpecker made the American rub his eyes not only because of its general color, but also its notes, which strikingly resemble those of our yellowlegs. In the fields skylarks were restlessly flying about, with an occasional phrase of their matchless song. Goldfinches wandered about looking for thistles, and linnets, tree pipits and yellow buntings were constantly rising from the ground and dashing off in all directions. The latter is one of the few common birds of Europe with a dash of bright color. It is, however, an alarmist, constantly annoying the ornithologist by its strident chirp of alarm from the nearest bush or telegraph wire, continued long after the imaginary danger is past, and acting as a signal to less common species to make off. Its song is a slow monotonous trill, which incessant practice fails to improve. English country folk claim that the bird says, "A little bit of bread and no ch-e-e-s-e." Occasionally with the common yellow-hammer was found the rarer cirl bunting, with a black, green and yellow striped head stuck incongruously enough on a dingy body, and with an apparently colorless personality. In all about fifty species of birds were seen around Chaumont.

On October 2, the writer was sent in a truck to the Vosges sector to deliver some dispatches to divisional headquarters. The autumn migration was in full swing at this time, and birds of various kinds roamed over the country in flocks. Jays, magpies, rooks, and carrion crows were everywhere, and the first hooded crow of the season was noted. Larks, starlings, buntings, chaffinches, and goldfinches were observed every few minutes. Very few swallows were left, however, and only one house martin was seen, the very last of the dying year as it proved. As we proceeded east the hills became higher and higher until we plunged fairly into the Vosges Mountains, rising and twisting through the spruce forests to Saint-Dié, the headquarters of one of

the divisions. The town is in an open plain with the German lines on the tops of the hills a little more than a kilometer away. The valley road which was in plain sight was carefully camouflaged, but, even so, one felt quite conspicuous in a truck. The country had been heavily shelled; every house was in ruins, so I was not particularly surprised when I did not note a single bird. Saint-Dié itself was partly in ruins, and was considered an unhealthful spot due to constant bombing, shelling, and gassing—the last apparently the favorite method of annoyance. Everybody carried a gas mask at all times, and had picked a cellar into which to retire rapidly when a yearning for seclusion seized him. It was astonishing, therefore, to see the full quota of house sparrows quarreling on the roof tops, the swallows flying up and down the main street. They had no gas masks, and it is hardly likely that they descended to cellars. Just what they did was a mystery. As dusk gathered, the guns began to thunder and rumble a scant mile away. In the garden of the old château which did duty as Headquarters, was a mountain ash tree laden with fruit. Here by the light of the setting sun, with the air pulsating with sound, three beautiful bullfinches were peacefully feeding on the crimson berries, heedless of three Fokkers which droned directly overhead. Unperturbed and unhurried they finished their meal, and then disappeared in the gathering gloom, leaving behind an impression so strong by its sharp contrast that it is graven deeply on my memory.

The end of October I was ordered to the First Army Sector. The hills northwest of Verdun had been selected as an excellent sending station for a certain type of balloon, and I was sent there on November 2 to start a station. As we approached Verdun the country appeared more and more wrecked until it could be described as totally ruined in the hills to the northwest. There, where the flower of young French manhood had died by the tens of thousands, there was nothing but a succession of shell holes. The trenches were partly fallen in, the barbed wire entanglements were just as they had been left at the last triumphant advance, and here and there a few blasted tree trunks did duty for a wood. Vegetation even was scant. A kestrel hovered over the dreary waste, a flock of goldfinches twittered around a thistle, and a great gray shrike had taken up his quarters in a barbed wire entanglement.

As dusk fell we descended into a steep little valley to the ruined village of Frémonéville, and elected to spend the night in one of the few houses which still boasted of a roof. That night the artillery fire at the front rose to the intensity of drum fire. The Allied heavy guns were concealed in the hills along a line lying a mile or two south of us. These joined merrily in the chorus, so that in the early morning the ground fairly shook. The approach of dawn brought quiet, permitting a brief cat nap, and I was astonished to hear a wren singing in the rafters near by, as I woke up. A bird hunt in this ruined village and its outskirts started immediately. Wrens were common, the smashed roofs and torn rafters furnishing them an abundance of hiding places among which they ducked and bobbed. Robin redbreasts were also common, singing sweetly in every bush that remained. Along the little brook flowing through the village was a solitary white wagtail, and a great tit kept it some sort of company in a willow bush near by. House sparrows were chattering around the church, and a flock of tree sparrows were feeding around the horse pond. Add a flock of rooks flying past overhead and a pair of yellow buntings in a field just outside the village, and we have quite a list for such a locality. Later on a few scattered shells burst on a hillside about a quarter of a mile

away, to which the birds in the village paid not the slightest attention.

Somewhat later the bird hunt was rudely interrupted by the scream of a shell which fell near a field hospital on the outskirts of the village. A second shell, 14-inch high explosive, plumped through the roof of the church. This was the last straw for the sparrows of both species, which flew away in a mixed flock protesting harshly, their example being followed by the wagtail which departed in a different direction. The wrens and the redbreasts had all disappeared, and my men and I sought the seclusion of the nearest dugout. The shells kept falling for about an hour, but after a short while it became apparent that they were coming with clocklike regularity every four or five minutes. So after each burst I would go to the door of the dugout to look around and see what new damage had been done.

Right opposite me was a bush on each side of which masonry was piled in such a way that down among the roots there was quite a little pit, an excellent retreat from a bird's point of view. A robin redbreast had been singing in this bush all morning, and I was pleased to discover it among the roots, apparently alive and well, in spite of the fact that a high-powered shell had burst only a hundred feet away. One might think that the concussion alone would have killed so small a bird,—it is a bad enough jar to the human frame. Knowing possibly more about shells than the bird, I would appear immediately after the last piece of masonry had fallen down. The bird would be down among the roots, still as a mouse, and would not show any signs of life for about a minute, when it would begin to work up very cautiously toward the top of the bush. The scream of the next shell was the signal for both of us to dive hastily back into our respective retreats. Five minutes after the last shell had fallen this particular redbreast was singing sweetly from the top branches of its bush, joined by several others in various parts of the village, in marked contrast with the solemn-faced and quiet men who emerged somewhat later from scattered dugouts all over the hillside to take stock of the damage done, the lives lost, and the wounded who needed immediate attention.

It is, of course, obvious that a small bird has an infinitely better chance of not being hit by a shell fragment than a man. If, therefore, its resistance to shell-shock and concussion were about equal to that of man we would have a partial explanation of the existence of bird life in the war zone. Although it is highly improbable that a bird is equally resistant, nevertheless we must not overlook that best of preventives, a barrier. And here it is again obvious that a tree trunk, a brick, or a rafter, would serve as an excellent deflector of concussion and sound waves for a bird crouched behind it, whereas the objects mentioned would totally fail to help a man.

After all, the accounts, chiefly by English observers, of the existence of bird life in the war zone are too well substantiated to be questioned. Some explanation must be forthcoming, and is probably along the lines indicated above. Perhaps, too, the extraordinary powers of adaptability which account for the existence of common birds in France, a country so totally altered from its original condition, are again an aid in helping any given individual to endure so utterly abnormal an experience as shell-fire.

Conserving Our Natural Resources of Sugar

By E. F. PHILLIPS

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THE people of the United States consume enormous quantities of sugar made from cane and sugar beets, the average individual consumption during times of plenty being more than eighty pounds annually. There are produced within the boundaries of the United States several thousand tons of cane sugar and about twice as much from the sugar beet. From our outlying islands we get more than the total sugar produced on the mainland and we also import great quantities from other countries. We go to much trouble and expense to get this sugar supply and if the quantity is reduced, as it was during the war, we feel that it is a great hardship.

There is another source of sugar supply which the people of the United States have sadly neglected. The amount of nectar secreted by the multitude of flowers is large beyond our comprehension. This is secreted that insects and other pollinizing agents may be attracted to bring about the cross pollination of the flowers, and to this end this sweet liquid is poured out freely. The per cent of sugar in this nectar varies in the different species of flowers and is also influenced by environmental factors. Whether or not it is a thick solution, the amount of sugar in each individual flower at any one moment of time is exceedingly small, but the number of secreting flowers is stupendous, and they continue to secrete nectar for some time, so that it is quite conservative to state that the total sugar secreted by these flowers in a year exceeds the amount of all sugars annually consumed by the American people. If only we could get it all, war and rumors of war would not affect our sugar markets!

Unless collected, however, this nectar, from its very nature, soon disappears as the flowers wither, and is lost to human use. Any method for conserving a portion of this abundant resource must be through some agency that is ever on the alert for each fresh supply. Some of the flowers which secrete nectar are of such size and shape that only birds or moths can reach this nectar, and what they get is lost to human use. Then there are thousands of species of insects which seek out the nectar for their immediate use, and while many of these species are economically valuable, man does not get the sugar.

Of all these nectar-seeking species, the honeybee alone is capable of being used by man as an instrument for collecting some of this vast sugar supply in such form that it can be used as human food. In spite of all that we can do, most of this sugar will be lost, but far more of it might be saved if this insect could be put more widely into

the service for which its instincts and colony organization so well fit it. Even these useful insects cannot be considered as examples of brilliant efficiency when viewed solely from man's selfish point of view, for they use for their own purpose far more than the beekeeper can take away. There are produced, however, about 250,000,000 pounds of honey annually as the beekeeping industry is now developed.

The worker bees gather the nectar, take it to the hive, remove the excess moisture, change the sugar chemically, and finally store it for future use. They use honey, as we call the finished product, for their own food, to feed the developing brood, and to provide stores for periods of the year when not enough nectar is available to keep them in food. Nectar is not secreted throughout the summer season in most places, but comes periodically with the blooming of the various species of flowers, these periods being called the honey-flows. Then in winter, after the first killing frost, there is the long period during which the adult bees must be fed, for the honeybee is unique among insects of the temperate zone in that it passes the winter as an adult and still does not hibernate.

The amount of honey used by an average colony of bees to maintain its existence during the year is large. The strength of the colony varies from about 15,000 individuals at the close of winter to perhaps 100,000 at the peak of prosperity and then the number again decreases as winter approaches. These bees must be fed, not only as adults but as larvæ, and they use great quantities of food during the period of development. When we realize that a bee larva may increase in weight several hundred per cent in 24 hours, and that there may be 25,000 of these hungry larvæ in the hive at one time, it will be clear that the colony must maintain a plentiful larder to care for the family needs. It will, perhaps, not be far from the truth to assume that the total amount of ripened honey used by a good colony of bees is four hundred pounds during the entire year. This will vary enormously, for in lean years the bees do not rear so many young and thus their consumption more nearly fits their income, while in the fat years of nectar, if given the proper room and care, they carry on brood-rearing to the capacity of the queen, the colonies become stronger, and they gather still more nectar.

Assuming, then, for the sake of a definite figure, that every colony must have its four hundred pounds, it is clear that this must be gathered before there is any honey which the beekeeper may take away. The honey removed for human use is usually called "surplus" by beekeepers and this is literally its correct name. In years of plenty the task of finding so much nectar is an easy one and under such circumstances there is surplus for every beekeeper. Unfortunately in most seasons nature does not supply this sugar so freely, and only the beekeepers who manage their bees properly get a surplus. It is not the purpose of this article to tell what the beekeeper may do to increase the amount of honey gathered by the colonies, for this has been so well covered in bee literature and it is so long a story that we must pass on to the broader problem of planning to get more nectar by the promotion of the industry. Perhaps, in the average season and with the fairly good beekeeper the amount of surplus honey for each colony will scarcely exceed fifty pounds.

The honey removed for human use represents, according to our figures, only one ninth of the nectar gathered by the bees. In such an average season an apiary of one hundred colonies may gather nectar equivalent to 22½ tons of honey, whereas the honey crop, or that taken off by the beekeeper, will be only 2½ tons. That the worker bees from one hundred colonies can find nec-

tar sufficient to produce 22½ tons of honey within a radius of two miles will give some idea of the stupendous amount of sugar at hand in a region where the unsuspecting individual would see no sugar production. Of course the bees are not able to get all the nectar during rapid secretion, and in most places there are not enough bees to get one tenth of it. There are many locations where more than one hundred colonies may be kept with profit or where more than a fifty pound surplus is obtained. It really would appear from a study of these figures that the chief end of nature is to pour out sugar syrup.

In the face of these facts it is regrettable that so many beekeepers in the United States fail to get even the small percentage which belongs to them. There are parts of the United States where nearly 90 per cent of all colonies of bees are kept in hollow logs or plain boxes, in which the combs cannot be handled. There are few places where the box hive is not found and probably one third of the bees of the country are so housed. Such beekeeping is almost as bad as no beekeeping at all, for bees in such hives cannot be handled and, without the contribution made by an intelligent beekeeper, the surplus honey of a colony is usually exceedingly small. In this case both the equipment and the management are poor.

It is not enough to buy good hives, however, for the greater number of those beekeepers who have their bees in such hives fail to get their full share of the crop. By failing to give the bees proper attention during the winter, by providing insufficient room for storage of honey (a mistake which is well-nigh impossible to understand and yet one which is most common), and by failure to control swarming, the crop is often reduced one half or more. The equipment is good but the management is poor. It is a common saying that the beekeeper invests one part of money and nine parts of brains in his business. If he leaves out the major investment, failure is sure to follow, and this most necessary article is not on sale by the dealers in hives.

The bright side of the picture is seen in the commercial apiaries throughout the country—even though their number be relatively small—where the bees are properly housed in good hives, where swarming is controlled, where the bees are given just the right amount of room for storage at just the right time, and where they receive adequate protection and care in winter. The number of such apiaries is increasing in an encouraging manner throughout the country, but there is still room for more. Beekeepers who take the proper care of their bees receive an adequate return for their labor and, as it is only the good beekeeper who gets all the available crop, it may safely be stated that the honey crop is chiefly traceable to study and care. Many beekeepers in almost all parts of the country receive a good living from their bees and have incomes equal to those of the good farmers in other lines of agriculture, resulting from the proper directing of the energy of the bees.

As it is only the good beekeeper who helps the bees to conserve much of the vast sugar supply of which mention was made earlier, it will be clear that from the standpoint of national economy it is most desirable to encourage more such beekeepers to go into the business. It will be equally clear that it is a detriment to have those take up the business who will not or cannot make the major investment—that of brains. We do not want in the bee business those who have no brains, but there is little danger from that class. The class which may do actual harm, and which is perhaps the greatest handicap to beekeeping as an industry, consists of those who have the necessary brains but who do not intend to make the investment.

Obviously, I refer to those owning a few colonies of bees, who take it for granted that "bees work for nothing and board themselves," who occupy territory which might better be occupied by commercial beekeepers, who, through lack of care, often allow their bees to be a menace to all the bees about them through the dissemination of disease—in short, who desire to be merely amateur beekeepers. The amateur beekeeper, usually the suburbanite with a few colonies, is rarely of benefit to the beekeeping of the country. He may get a little honey at times for his own use and, if he has a little more than he needs, he may sell it in such a way that he spoils the market in his community for the sale of honey produced by a beekeeper who makes his living through the bees. If the beekeeper with a few colonies would study the problems of beekeeping, would study his bees, and really retain throughout the work that enthusiasm with which he began, he would be a help and not a hindrance to the development of beekeeping.

The only class of beekeepers who do more harm than the amateurs is that group usually spoken of in beekeeping circles as the "farmer-beekeepers." There is no reason why a good farmer cannot be a good beekeeper, for he is able to make the investment of both money and brains. The great difficulty is that just at the time when the bees demand attention, the general farmer is exceedingly busy with other work. Usually the bees back in the orchard are neglected from one year to the next, an easy prey to disease, never properly packed for winter, and of no profit to the owner. Whenever you see a few colonies of bees back in the orchard in unpainted hives or behind the barn in all sorts and conditions of boxes, you may be sure that there is no profit here, and probably when the apiary inspector comes along for bee diseases he will "lose his religion" in trying to induce the owner to clean up the wreckage.

I have tried to indicate why it is that all the agencies which are honestly trying to build up the beekeeping industry in the United States are making an effort to induce more people to take up beekeeping as their vocation, and are more or less openly discouraging the amateur. We all realize that everyone who goes in for beekeeping must one day make the start, and usually this start is a small one. Out of the great group of amateurs—there are now about 750,000 of them—must come the professional beekeepers of tomorrow. There is, however, an adequate supply of material on which to work in trying to make better beekeepers of those who now have bees, and it is unnecessary to try to make more beekeepers. As time goes on, some of those who now make a business of beekeeping may be driven out by the inroads of bee disease, unless they are able to invest enough brains to make the fight. Some of our present beekeepers engaged commercially cannot make this investment for, as before stated, they cannot get brains from the hive dealer. We will want some improvement in the personnel of beekeeping, and it may well be that there are persons who now know nothing about bees who might make our very best beekeepers. The risk of making an average amateur is too great to run and, as a result, almost every person engaged in helping beekeeping in this country shudders a bit when anyone suggests taking up bees.

Beekeeping offers opportunity as a commercial enterprise for thousands of alert people. The work of the beekeeper, while not at all a sinecure, is not so hard as that of many other lines of activity; there are abundant periods for recreation and study especially during the winter, and the returns are good. As has been stated, the investment is one part money and nine parts brains. There is no branch of agriculture in which the return is so large in proportion to the financial investment

as in beekeeping, but if the money is invested without putting in the larger investment, there is no hope of success. The prospective beekeeper may be sure that he will be associated with good people in a work which demands such care and study and he will be well repaid for his work and study.

To the person who fondly hopes to have a few colonies of bees just back of the two apple trees to the rear of the suburban home, the best advice is to buy any honey needed at the top of the market, put money into W. S. S. instead of into bees and hives, and read Maeterlinck for the beekeeping experience. It will be found more profitable than the plan which he has had in mind. He may, if he wishes, still look forward to the time when he buys his farm and can keep bees on that, but most suburbanites do not buy the farms to which they look forward. The best way to conserve the vast nectar resources of the United States is to leave the production of honey to professional beekeepers, for they and they alone can save it for us.

For those who do not engage in beekeeping or who may feel that this discussion has barred them from a pursuit to which they have looked forward, there still remains one of the great joys which have their origin in beekeeping; there is the honey to eat. Comb-honey is of course a pure product just as made by the bees and it is not glucose in paraffin cells, as the sensational press periodically asserts in an effort to portray the ingenuity of the Connecticut Yankee. Extracted honey, that is, honey in liquid form, separated from the comb, is also pure for, since the passage of the Pure Food Act of 1906, honey adulteration is indeed rare. There is probably no food product on the market more free from contamination than either comb or extracted honey.

It is quite possible to put in words an assurance of dietetic fitness and chemical purity. It is not possible to string together a group of English words which describe adequately the taste of fine honey. Its beneficial properties and its value as a food for children and invalids are quite explainable, but the attractiveness of honey, the reason we eat it, lies in its flavor, which is quite beyond words. Each species of nectar-secreting flower gives forth a supply of characteristic flavor so there is abundant variety and a flavor for each taste. It is the nectar of the gods and the very name is sweet.

It is a conservative estimate that the sugar secreted by the flowers of this country each year exceeds the total amount of sugar consumed annually by the American people. Of all the nectar feeding insects, however, the honeybee alone can be used by man for saving nature's vast output of sugar. Each colony requires about 400 pounds for its own living, this leaves the fairly good beekeeper a surplus of about 15 pounds. Hope for the industry lies in commercial apiaries, but only the thoroughly informed, experienced, "good beekeeper," should be encouraged to enter the work

The Evolution of the Human Face[1]

Especially the story of the evolution, from fish to man, of the lacrymal bone as one of the bones around the eye socket

By WILLIAM K. GREGORY

EARLY in the nineteenth century Cuvier, the famous French comparative anatomist, and his colleague, the elder Geoffroy Saint-Hilaire, observed that in the skulls of crocodiles and alligators there are four bones around the orbits or eye sockets, and that two of them respectively correspond in position to the lacrymal or tear bone of the human skull, and the other two to the jugal (malar) or cheek bone.

About the same time it was noted that in fishes also there is a ring of bones around the orbits, and in 1818 Julius Victor Carus sought to identify the human lacrymal with the first suborbital bone of fishes. These identifications by Cuvier and Carus were further studied and accepted by Sir Richard Owen and later anatomists down to our own time; in 1910, however, E. Gaupp, of Freiburg, cast serious doubt upon them, holding that it was the so-called "prefrontal" or front upper element of the circumorbital series of lower vertebrates, which was the real homologue of the human and mammalian lacrymal.

As the problems thus raised ramify in many directions, I have closely examined the evidence cited by Gaupp, and during the last few years I have studied the bones around the orbits in all classes of recent and extinct vertebrates from fishes to mammals. I conclude, however, that Gaupp was mistaken, and that Cuvier and Carus were right. This is one of the conclusions in a report on the evolution of the lacrymal bone of vertebrates, comprising about two hundred figures, which will shortly be published in the *Bulletin* of the American Museum of Natural History, and upon which the present article is largely based.

In an earlier article in this magazine I endeavored to summarize the main stages in the evolution of the eyes, nose, and mouth. In the present article attention is centered chiefly upon the evolution, from fish to man, of the bony elements around the orbits or eye sockets.

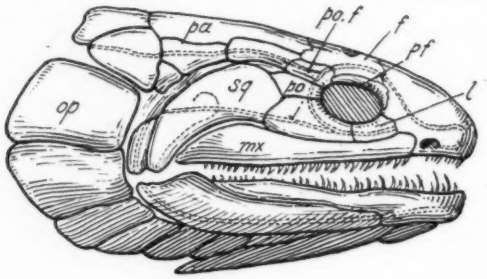
In the earliest fishlike vertebrates the whole head was covered with a tough skin surrounding the eyes, the nose and the jaws and covering the roof of the skull and the region of the gills. In the stage represented by Fig. 1 of our series this tough skin had already acquired a bony base which is preserved in many ancient fishes of Devonian and later ages and is still retained by the gar pike and other lowly forms of living fishes. At that time the eyes were surrounded by a ring of about five flat skin-bones named respectively the prefrontal (*pf*), the postfrontal (*po.f*), the postorbital (*po*), the jugal (*j*) and the lacrymal (*l*). These were grooved on the surface by a branch of the "lateral line" canal encircling the orbit.

Between this and the next stage of evolution there is a great gap in the palæontological record. But the cumulative evidence of comparative anatomy and embryology indicates that the oldest known four-footed animals, known only from certain footprints in the Upper Devonian and Lower Carbon-

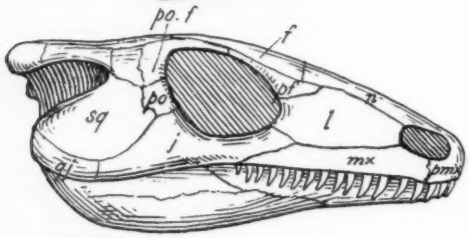
[1] Continued from the AMERICAN MUSEUM JOURNAL, October, 1917.

EIGHT STAGES IN THE EVOLUTION OF THE HUMAN HEAD

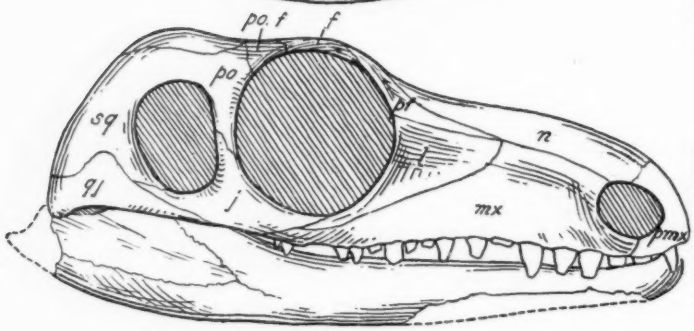
To show especially the evolution of the lacrymal or "tear" bone as one of the bones around the eye socket



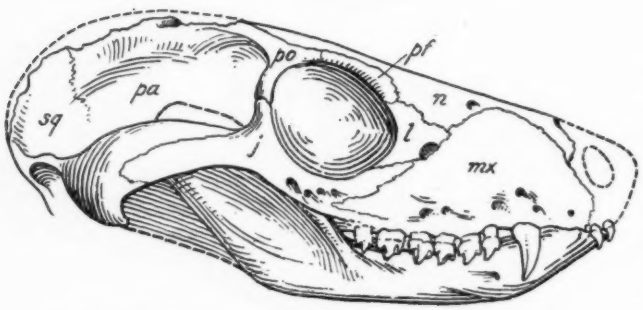
Stage 1—Head of a primitive fish, *Osteolepis*, of Devonian age, showing the five bones of the primitive circumorbital series[1] (After E. S. Goodrich)



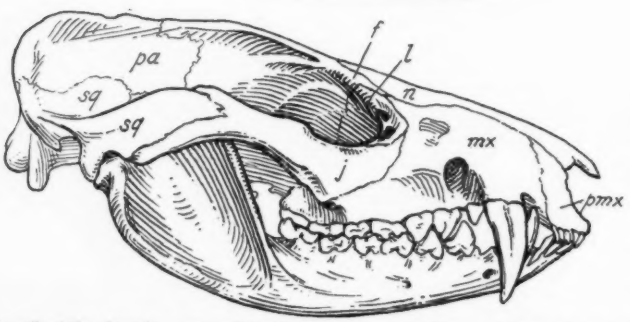
Stage 2—Head of the most primitive known reptile, *Seymouria*, from the Permian of Texas. The primitive upper jawbone (*mx*) is comparatively slender and lies entirely below the lacrymal, which extends from the orbit to the nostril (After S. W. Williston)



Stage 3—Head of a later primitive reptile, *Mycterosaurus*, from the Permian of Texas. The upper jawbone (*mx*) has grown up over the lacrymal (*l*) and is in wide contact with the nasal (*n*)

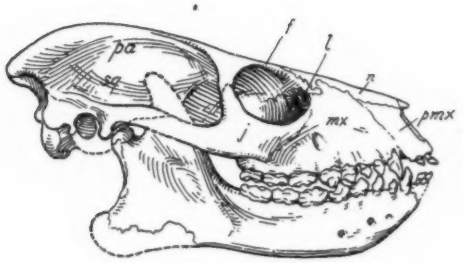


Stage 4—Head of a still higher reptile, the mammal-like *Ictidopsis* of Triassic age, South Africa. The upper jawbone (*mx*) is still larger and the whole head is very mammal-like, except that the reptilian prefrontal (*pf*) and postorbital (*po*) bones are still present

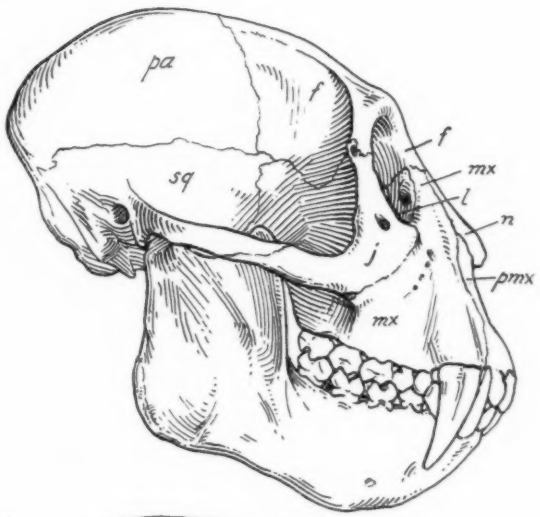


Stage 5—Head of a Virginia opossum representing the primitive mammals. The upper jawbone (*mx*) has now grown upward around the lacrymal (*l*) thus reaching the frontal (*f*). The prefrontal and postorbital bones are no longer present

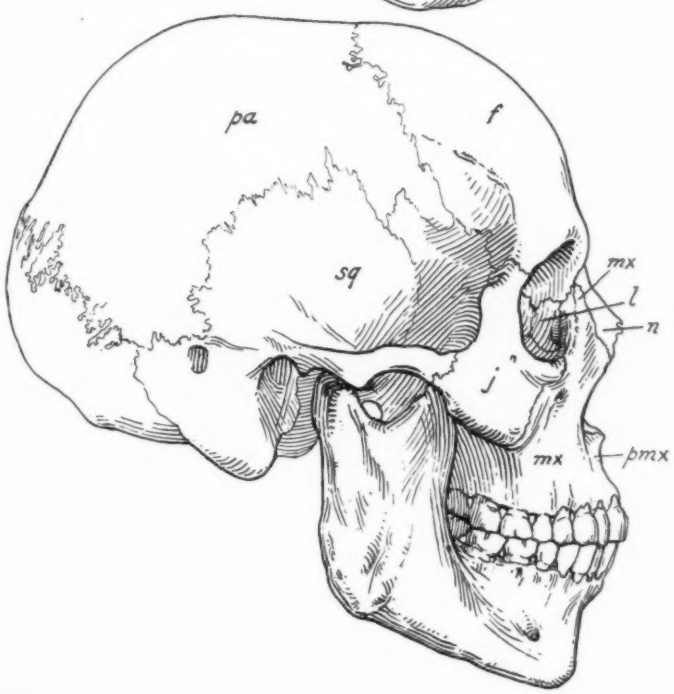
[1] In all eight drawings the abbreviations are as follows: *f*, frontal; *pf*, prefontal; *po.f*, postfrontal; *po*, postorbital; *l*, lacrymal; *n*, nasal; *mx*, maxillary; *pmx*, premaxillary; *j*, jugal (cheek); *pa*, parietal; *sq*, squamosal.



Stage 6—Head of a primitive Primate *Notharctus* of Eocene age, Wyoming. The lacrymal (*l*) is pushed to the inner wall of the orbit. A new rim behind the orbit is formed by outgrowths from the frontal (*f*) and cheekbone (jugal, *j*)



Stage 7—Head of an Old World monkey (macaque), showing the forward direction of the orbits, the retreat of the lacrymal bone to the inner wall of the orbit, the formation of a bony partition behind the orbit, the beginning of the expansion of the brain case and of the shortening of the face



Stage 8—Head of a man, showing the final stage of evolution. The lacrymal bone remains much as it was in the preceding stage, but the eyes are now directed wholly forward, the brain case is greatly expanded and the face extremely shortened and deepened

iferous rocks, were the descendants of certain very progressive "lobe-finned" or rhipidistian fishes, which had begun to use their fore and hind paddles as limbs, crawling about the margins of pools and swamps, and developing such incipient lungs as are found in the lungfishes of the present day. In these transitional creatures the gills were probably used only in the larval aquatic stage and gradually disappeared in the adults. Consequently the numerous skin-bones covering the gill-chamber in fishes and called the opercular series (*op*, Stage 1) disappeared, along with the gills themselves, so that in the oldest known four-footed animals (Stage 2) there is a great notch at the back of the skull on each side, representing the outer part of the primitive gill-chamber.

Thus, after an interval of millions of years during the emergence of the four-footed vertebrates from fishes, the rocks reveal to us the second great stage of this line of evolution, represented by the reptiles and amphibians of the Coal Measures and succeeding ages. In these animals (Stage 2) we find the same ring of five bones around the orbit which was first developed in the fishes, but now the several elements of this series are more differentiated one from the other. The lacrymal bone (*l*), at the lower front corner of the orbit, is pierced by a duct corresponding to our tear duct, which it is believed is a modified remnant of the lateral line canal. The jugal (*j*) or bone beneath the orbit now suggests the beginning of the zygomatic arch or cheek bone of higher types. At this stage the lacrymal extends from the orbit to the nostril, and the maxilla (*mx*) or upper jaw bone is a slender element which is widely separated from the nasal (*n*) by the lacrymal.

In the third stage (Stage 3), represented in certain reptiles from the Permian of Texas, the lacrymal is restricted through the upgrowth of the maxilla, which acquires a wide contact with the nasal. Here, also, we have the beginning of the temporal fossa or opening for the jaw muscles behind the orbit.

The fourth stage (Stage 4) is represented by the mammal-like reptiles of the Triassic age found in South Africa. In these wonderful saurians there is a surprising mixture of mammalian and reptilian characteristics. The region around the eye is very mammal-like. The upper jaw bone is much larger than in earlier stages and the lacrymal is still more restricted. The zygomatic arch is extremely mammal-like in form and so is the temporal fossa.

The fifth stage, which was attained in the latter half of the Mesozoic era or Age of Reptiles, is preserved even at the present time in the opossum (Stage 5), one of the most primitive of existing mammals. In this stage the upper jaw bone (maxilla) has grown upward around the lacrymal, which is now further restricted. As compared with the ancestral reptiles the greatest changes in this region in primitive mammals are the loss of the prefrontal, which exposes the frontal, and of the postorbital, which makes the orbit widely continuous with the temporal fossa. The stout zygomatic arch is now fully mammalian in form.

The sixth stage is found in the very ancient Primates from the Eocene of Wyoming, here represented by *Notharctus osborni* (Stage 6). The lacrymal has now greatly dwindled and withdrawn to the inner wall of the orbit as in many existing Primates, this reduction and retreat within the orbit being probably associated with the reduction of the parts of the nasal cavity which the lacrymal covers. The orbit is now guarded in the rear by a bony rim, which is, however, by no means the same as that in reptiles (Stages 2–5), since it is now formed, not by the

original postorbital bone (*po*), which has been lost, but by a new bony outgrowth or postorbital process from the frontal bone, which meets a similar new extension from the jugal. At this stage the face is somewhat shorter than it was in primitive mammals and reptiles, but the eyes still look outward.

The seventh stage (Stage 7) is preserved in the monkeys, especially those of the Old World, such as the macaque. These have advanced widely beyond the primitive Primates in the fact that the orbit is now shut off from the temporal fossa by a new partition growing out from the above-mentioned postorbital process of the frontal and jugal bones. This great change is associated partly with the forward pointing of the orbits, which also causes the lacrymal bone to be pressed tightly against the inner wall of the eye. The large opening of the lacrymal canal or tear duct is now between the lacrymal and the upper jawbone or maxilla. The bony face is shortened and deepened and the whole brain case is expanded.

The final or human stage (Stage 8) presents only an emphasis of the features already noted (Stage 7) in the monkeys, and is already attained in the higher anthropoid apes (see drawing on this page). The eyes now look directly forward, the brain case is enormously expanded and the face greatly shortened and deepened. The position and characters of the lacrymal are essentially the same as in the preceding stage except that the tear duct is still larger.

The series as a whole shows the dominating parts played in this evolution at first by the loss of the opercular bones following the loss of the gills; secondly, by the development of a temporal fossa and of a zygomatic arch in connection with the more efficient functioning of the jaws; thirdly, by the forward shifting of the orbits to obtain better vision; fourthly, by the final expansion of the brain case; and fifthly, by the retraction of the jaws beneath the brain case.

Thus in the course of many millions of years the lowly head of the Devonian fish has been refashioned into the voluminous brain case and forward-looking face of man.

Forepart of the skull of a young chimpanzee showing subhuman character of the bones around the orbit, especially the lacrymal (*as*, alisphenoid; *pl*, palatine; other abbreviations as on page 422). Thus in the higher anthropoid apes, as in man, the lowly head of the Devonian fish has been refashioned, during the course of many millions of years, into the large brain case and the very different forward-looking face

WEATHERED OUTPOSTS OF THE FOREST

Glassy spicules of ice and sharp unworn sand grains grind at the windward side of the trunks, sometimes eating almost to the heart. On the leeward side the trees put forth their toughened branches and needles. The limber pines stand alone and take the punishment of the winds in unprotected spots where their neighbors, the spruces, cannot live

A snowstorm at timber-line.—The snowfall along the continental divide in Colorado is one of the heaviest of the country. In the immediate vicinity of Longs Peak it feeds the Grand River on the west and tributaries of the Platte on the east. "Eternal snow" lies all along the Front Range and from its border there flows a sheet of icy water during the summer days

The Wars of the Wind at Timber-line

THE FOREST RANKS IN THE DRY WIND-SWEPT HIGH ALTITUDES OF THE ROCKY MOUNTAINS ARE BEING DRIVEN DOWN THE SLOPES

By ENOS A. MILLS

Illustrations from photographs by the Author

FOR ages the high, dry, winter wind had blown out of the west across the Continental Divide. Down the eastern slope these winds swept roaring against the ragged, battered upper ranks of the forest at timber-line. At one place in the Rocky Mountain National Park they came down across a wide treeless moorland between two lateral moraines of huge size. They dashed so fiercely against the forest front that the aggressive trees had never been allowed to do more than peep over the edge of the inclined moor. Again and again an adventurous seedling had dared the treeless space only to be blown to pieces before it could get a good roothold.

One day far up a mountain-side a cliff crashed and fell. The ice had at last wedged it off. It plunged and rolled down a steep slope with great leaps, and went to pieces. A few of the pieces tumbled far out on this moor. The largest stone formed a small windbreak a few hundred feet in advance of the forest's wind-battered edge.

In due time a few daring seeds sought to start a tree outpost in this shelter. They succeeded. In a close cluster they grew up. When they rose above the upper surface of the rock the terrific winter wind cut them off with sand blasts and the cutting edges of glassy sleet. New trees from time to time found a foothold to the leeward of the stone's pioneer tree cluster. Thus a line of trees gradually extended in a

long wind-battered row, thick as a hedge, to the front ranks of the forest. The wind did not allow a tree to start or a limb to extend beyond the sheltered edges of the stone.

The timber-line of which this windrow was a part stretches along the eastern or Atlantic slope of the high Continental Divide for hundreds of miles. The Engelmann spruce and the Arctic willow represent the tree growth in the moister places, while it falls to the lot of some variety of the limber pine to maintain the forest front on the dry wind slopes and rock ridges.

Timber-line, like the shore line of the sea, bends and curves. Here a mountain-side cañon causes it to sweep back like a bay of the sea, and there it thrusts itself out around a peninsula-like headland. In places the topography causes it to extend for a mile or more in a straight line. Next it comes to an end upon an out-cropping of barren rock which offers it no soil; and in places a drift of "eternal snow" holds it at bay; while on slopes and ridges the dry and devitalizing winds say, "Thus far and no farther."

The winds and gales that strike and beat and break against the front ranks of the forest, roar as intensely as a storming sea upon the shore, and with all its terrible eloquence.

Wind is the strongest factor in the life of these timber-line trees. This is shown in their attitudes and shapes. Standing trees are tilted toward the east, the vinelike, crawling trees are headed east, and those standing with banners and pennants of long, tattered limbs and foliage, extend their arms only toward the east. All proclaim, "Out of the west come the forces that direct us." At timber-line, wind, the sculptor, has carved for himself a thousand graphic tree statues that proclaim his presence and his power.

The stone on the moor continued to shelter the windrow at timber-line. Each winter around the stone the violent winds raged, and pounded it almost incessantly. During the summer months the wind rarely blew. Then brilliant flowers stood thickly in a green and snowdrift-dotted Alpine scene. But with the coming of autumn the wind again came pouring out of the west across the peak-broken heights. Through the long winter it commonly blew from the same quarter.

As it poured around the stormward corners of the stone, the wind gradually blew the earth away. Then along the stormward front of the stone it connected these corner erosions with a channel. Finally it began to undermine this immovable wind-defying piece of granite Each spring and summer the water from the winter snows and from the rains carried forward the eroding, undermining work of the wind.

Occasionally an accident came to a tree or two in the windrow and a slight opening was left, between the grizzled edges of which a man might squeeze through. One day a bowlder rolled down and smashed a larger opening. But most of the trees in this long, narrow hedge interlaced still more closely with new limbs. The wind did not allow them to extend their tops upward or their arms outward beyond the line determined and sheltered by the stone. Each winter the hundreds of tiny adventurous twigs that had during summer grown beyond the side or the top lines were clipped off by the wind.

A long, long time the stone remained. Upon it many a white ptarmigan alighted; upon it, too, the crested noisy jay, the quiet camp-bird, and the curious magpie often sat to look upon the scene. Around it lived the bighorn sheep. Beside it a grizzly once dug for a chipmunk.

On the wide moor here and there a partly embedded rock fragment sheltered a tiny persistent tree. Here and there a bowlder that had rolled down from one of the moraines sheltered

ON LONGS PEAK, COLORADO, AT AN ALTITUDE OF 11,500 FEET

The timber-line, which is one of the most marked boundaries of plant zonation, sweeps in a sinuous course along the higher ranges of the Rockies, now ascending a protected gully, now driven down the mountain's side from a wind-swept lane or rocky prominence. After this manner the Arctic-Alpine and Hudsonian, or forest, zones lap past each other for vertical distances as great as a thousand feet. In the upper mountain forest of northern Colorado the Engelmann spruce and limber pine chiefly abound, while above the tree limit lies a rocky tundra with its lichens, low willows, and herbs. Here the ptarmigan, pipits, and finches find their breeding grounds in spring, building their homes among the rock débris. Lichens are the most important element in breaking up the rocks to form the minimum of soil in which mosses, grasses and shrubs may gain a foothold

somewhat larger growing trees. A pile of débris that a landslide had brought down sheltered a grove almost twelve feet high.

Immovable the great stone lay on the moor. Dust and trash accumulated beneath the trees in its shelter, as under any hedge, and formed a barrier which blocked the water coming down the slope of the moraine. This cut a small channel alongside the tree row. This water joined the wearing, undermining forces of the wind that ever worked beneath the stormward foundation of the protecting stone.

Immovable the stone continued to lie through the wonder summers amid Alpine flowers, and through the roaring windy winters, while invisible chemistry tinted it with many hues and the lichens came to color it. But at last the wash of water and the sweep of winds dug a great hole in front and beneath the stone. Early one summer as the frost was vanishing from the soggy earth the stone settled forward and rolled over into the hole on its side, leaving the windrow of trees to the winds. This was only a few years ago, but today those trees are only a memory.

Most of the forest front is without a windbreak. While ridges, landslide débris, and bowlders here and there afford protection, the main timber-line breasts the wind unsheltered. If one follows along this strange boundary line, the timber-line, he will see in some places trees which have been struck by lightning, others mowed by snowslides and in places crushed, and in still other places trees protected by bowlders or landslides that have come down from the treeless heights above. Trees that have grown up to the leeward of a shelter are quickly trimmed and markedly changed shortly after the sheltering barrier is removed.

A tree may be forced out of plumb by prevailing winds and then be caught by heavy snow and crushed down and held so long that it never regains its upright position. There are acres of trees prostrate, chiefly from the effect of high winds, but perhaps incidentally from the weight of winter snow. A combination of wind and snow causes many a tree, at a foot or less above the earth, to abandon the growth of its top and give all of its energy in sending out and maintaining long limbs which radiate in all directions. Many of the long, storm-tempered limbs are nearly as tough as steel. The smaller limbs may be knotted without breaking.

In other places trees grow along the ground to the leeward with a few flattened limbs streaming out parallel to the top. The few scattered erect ones possess limbs on only the leeward quarter. Limbs on the stormward side have never been allowed to grow. Many trees thus are standing, worn away to the heart on the stormward side, the naked bones showing, while on the leeward there is the green bark and long out-streaming limbs.

Many of these dwarfed ancient looking little trees are not two feet high. Yet they are two and three centuries old and look as old as the mountains. Some are two or three feet in diameter and less than eight feet high. Numbers of trees, although at least a century old, are but small grizzled shrubs. In places a number of these may be growing together in a beautiful wild-flower garden composed chiefly of dwarfed flowers,—flowers with stalk and bloom perfectly formed but less than one inch in height. Like the trees themselves, many of these dwarfed plants have a strange and extensive root system, while others, like many of the trees, are growing on only the leeward quarter.

Areas of a "block" or more are covered with low matted growths as smooth and unbroken as the trimmed surface of a hedge. They are clipped off almost as level as a lawn, with the

SHELTERED FOOTHOLDS AGAINST THE WINDS

Dwarfed, ancient looking little trees, matted together behind a sheltering rock, maintain themselves far beyond the tree limit. Their tops are clipped off as in a trimmed hedge, for any adventurous twig that reaches too far upward during the summer is certain to be dried out and killed by the winter winds. The work of the wind is not altogether destructive, however, for it carries dust from the upper plateau to the nooks and corners of the glacier valleys to serve as soil where the meadow and, later, the forest can gain a foothold for advance in the never-ending struggle up the granite slopes

Limber pines grow in exposed spots among the forests of Engelmann spruce. The spruces stand straight and true wherever they are found, but the pine develops a stunted, gnarled, and weathered appearance as a result of its rigorous warfare with the winds. As is the case with all plant forms at the limits of vegetation, the pines increase very little in size in a single season so that a veteran of many decades may have developed but a small stature. (Photograph taken at an altitude of 11,200 feet, on the Front Range of the Colorado Rockies)

numerous twigs interlacing. Here and there in these growths a single tree trunk, badly battered, may stand like a tattered flag or banner. Even in the worst wind-swept groves one may see, waved far aloft, the plume of one or more pines.

On a moraine nearly 12,000 feet above sea level I once saw in the distance a tree of striking appearance. Its substantial trunk was three feet six inches in diameter. The total height of the tree was seven feet nine inches. For two feet it was limbless, then came a great whorl of limbs. A few of these at the base were nearly a foot in diameter. Apparently the tree had been shielded and its form and height determined by the presence of a few large bowlders thirty or forty feet up the

The spruces form the regular heavy growth of the upper forests where they are associated with balsam fir. On the higher and more exposed localities the fir is replaced by foxtail and limber pines. Flowers in profusion, full of color although not highly varied, blossom on the mossy floor of the forest and in the Alpine meadows above. The spruce-fir forests are chiefly important as conservers of the water supply on which the surrounding country relies for irrigation; their value as lumber is slight, although the spruces may be employed for mine timbers

This squatty giant of the timber-line, although not eight feet high, has a trunk three and one half feet in diameter. Such tabular forms are frequently assumed at both the mountain and polar tree limits. The height of the tree beyond which upward growth ceases is determined by the average depth of the snow, for twigs that project above the drifts throughout the winter are usually cropped by the dry Alpine blasts. Beyond the tree limit the same conditions reduce the tree growth to mere ground mats of shrubs. (Compare with page 431)

slope. The annual rings in this tree are exceedingly thin and the probable age is about two thousand years. It was killed by a forest fire in 1900. Its wood is so dense, fine-grained, and tough, that the preservative treatment given it by the fire should enable it to endure for a century or longer.

Dry winds are the deadly ones. Trees on wind-swept beaches, the very front ranks of the forest at the seashore, are also greatly exposed, but the air here is damp. Sometimes in winter in the Rockies extremely dry winds blow for days in succession. If their coming has been preceded by a drought they have a most devitalizing effect on the trees. Apparently they absorb much of the moisture—the very life—from the trees, and as a result the fol-

The prevailing winter winds which bring the heavy snowstorms blow from the west so that the trees are bent eastward and tend, after years of pressure, to put out their branches and point their heads permanently in this direction. These winds, sweeping the high ranges, sometimes blow more than a hundred miles an hour with great regularity in direction. Only where the direction and strength are continuous and persistent, as on high mountains and along some stretches of seacoast, is such direct contortion of trees to be seen

lowing summer the needles of the trees turn brown. They are dead.

It is in the arid climate of the eastern front of the Rockies that high winds are most destructive. Dead trees in exposed places are literally eroded away. The lack of grass and other vegetation on the surface of the ground enables the wind to obtain tools of sand and gravel. These cut like sandpaper or powdered glass.

Timber-line as seen in the life of the individual man is a fixed, permanent line, but in reality, in the general view of time, timber-line is not fixed. Despite the aggressive work of the hardy trees which time has developed, the forest ranks in the dry wind-swept heights are being driven down the slopes. In moist places timber-line is slowly creeping up the heights, while in the drier regions, especially in the Rocky Mountains, it is losing ground. The surface of the earth is becoming drier. This condition in a few regions is favorable to trees, but over many wide and wind-swept stretches it is most unfavorable. One may travel for miles along the forest frontier without seeing a single young tree in advance of the old front rank of the forest.

Numbers of small pine trees, although at least a century old, are but short grizzled shrubs, contorted out of all resemblance to their kind in the forest. Down among the spruces the limber pines grow taller than at timber-line, sometimes as high as thirty feet in northern Colorado and fifty feet in southern Colorado. Owing to the compact annual growth of the Alpine form, it is very difficult to tell the tree's age without the assistance of a lens. The most potent factor in this stunting of tree growth is not the cold but rather the desiccation caused by persistent icy winds. The winds in winter rob the tissues of their stored-up water which they are unable to replace from the frozen soil

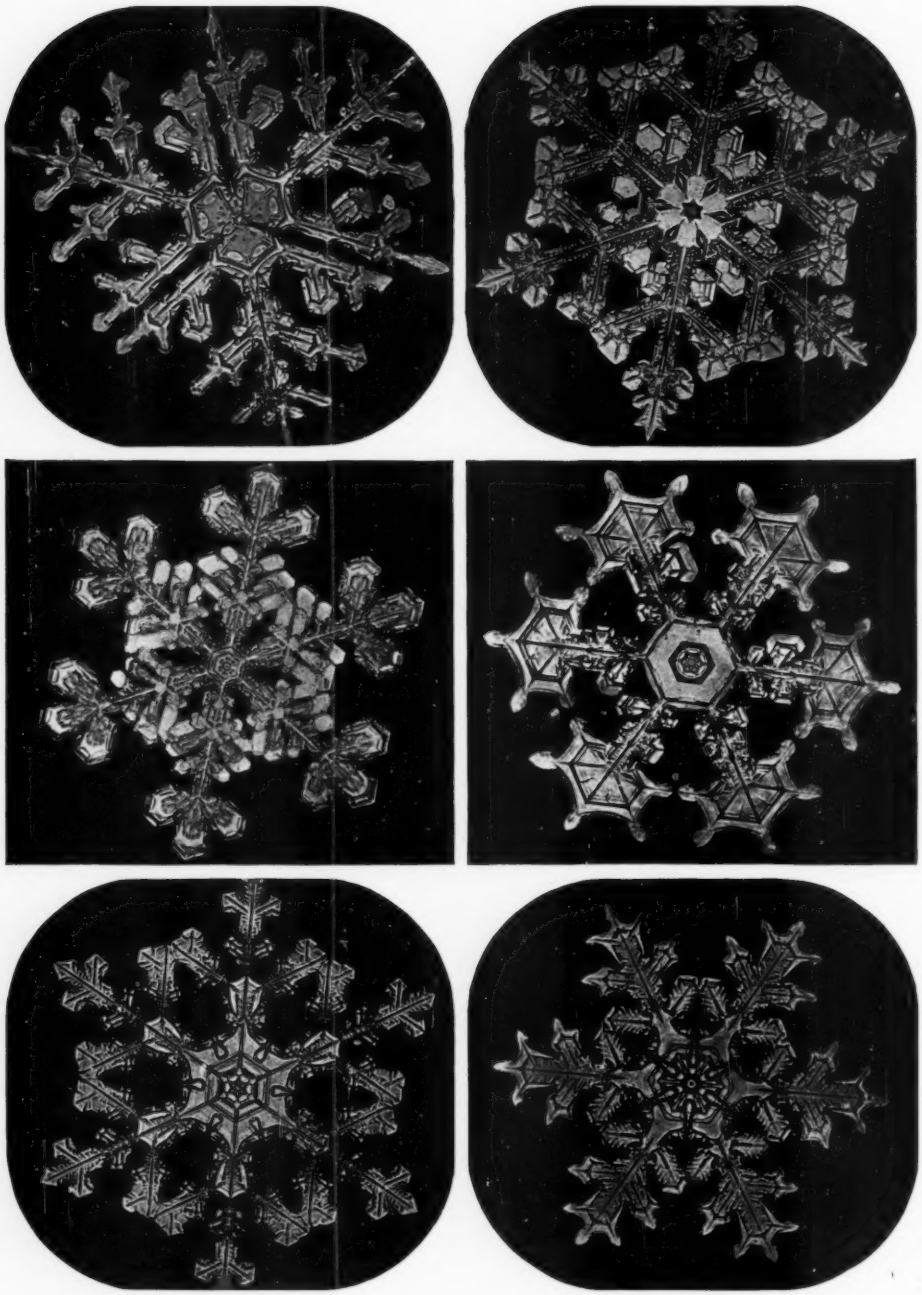
Here and there along the timber-line in the Rockies is a bleaching log or a sand-eroded snag—all that remains of a former tree colony. Its nearest living representatives are several hundred feet down the slope, where there is more moisture and more shelter.

The front ranks of the forest—the forest frontier—are fighting the winds on all of the high mountains of the world: in the forest's farthest north near the Arctic Circle, the timber-line lies low, only a few feet above the level of the iceberg-dotted sea; in the Alps it is more than a mile above the sea; under the warm equator its ranks climb high into the mountainous sky; and in the Rocky Mountains they are dwarfed and broken by battles with the winds on the dry heights more than two miles above the shore line of the sea.

The lot of a tree may be cast in a tropical jungle, on the ocean's shore, alone out in the plains, or in a favored clime as where the unrivaled Sequoias grow. Every tree tastes adventures and looks upon many stirring pageants, but none lives a more intense life than that tree whose shadows fall upon mountain snows—the tree which faces the winds of the high plateaus, bravely struggles for existence, and lives its vigilant and exacting life among high peaks and passes.

In places the trees grow along the ground to the leeward with a few flattened limbs streaming out parallel to the trunk. This condition is undoubtedly caused by the combined action of wind and snow, for the trees, while bent over in a blizzard, are buried under the great weight of snow, which bears down their branches and permanently alters their growth. Snow falls to a great depth on the high ranges and lies late into the summer season, drifts of "perpetual snow" being found down to the tree limit in protected spots

Protected from the winds among the bowlders and with roots crowded into cracks among the rocks, a solitary tree will start and persist in its lonely growth on the very fringe of tree vegetation. Seldom does its head rise above the protection, however, as it creeps eastward away from the blasting winds. The most astonishing feature in such growth is frequently the minimum amount of soil which the tree requires for its roots



COMPOUND STELLATE SNOW CRYSTALS FOR THE JEWELRY DESIGNER

The intricate and branching forms of this group suggest jewelry designs in gold or enamel and patterns for lace or machine embroidery. These most complex snow crystals are probably formed in intense cold such as is found in the high altitudes from which the snow falls during general storms or during local storms in zero weather. The central usually hexagonal ice crystals act as nucleus for the intricate branches whose ribs are for the most part hollow tubes. The upper left-hand crystal shows imperfect or asymmetrical growth from an imperfect nucleus

Art Motives in Snow Crystals

BOREAL STUDIOS CONTINUALLY MAKING NEW DESIGNS

By HERBERT P. WHITLOCK

WITH the resumption of manufacture upon a peace basis, a growing demand is being felt throughout the United States for American products which will express a distinctly American spirit in new designs. Manufacturers have voiced the opinion that an added impulse to applied art in this period of reconstruction of trade will come with the introduction of art motives which are not only striking but novel.

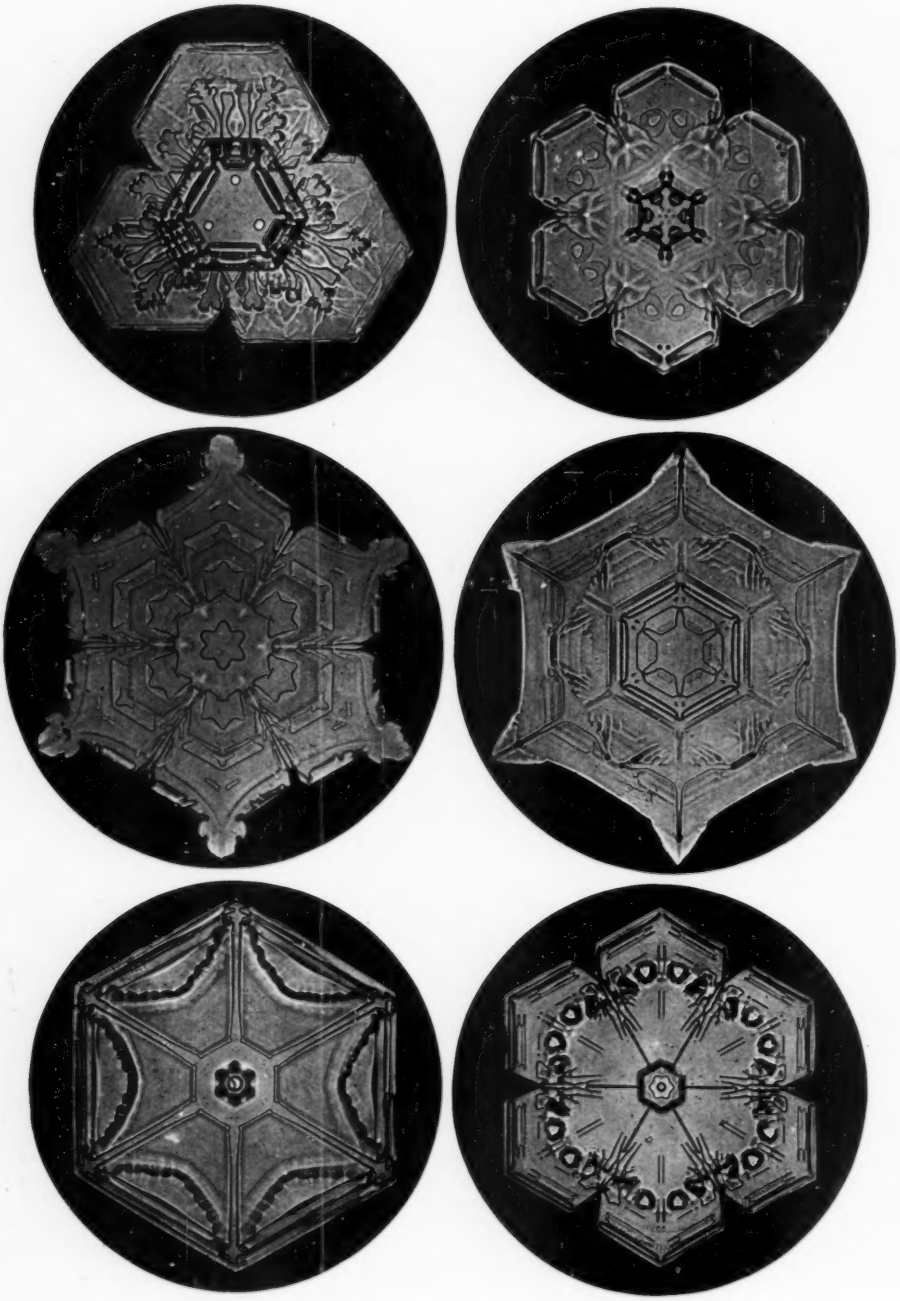
The forms of the inorganic kingdom have as yet played little part in the development of art motives which have, up to now, been dependent mainly upon geometric patterns and upon more or less conventionally treated plant or animal forms. And yet it would seem that at least some of the mineral forms could be successfully substituted for those more stiffly geometric patterns which have been handed down through the centuries as part of our art heritage.

Snow crystals, combining, as they do, a wonderful symmetry of form with a practically inexhaustible variety of six-symmetric outlines, offer a fertile field for the designer. The snow crystals illustrated in these four pages are only a few examples—chosen from many hundreds—of the intricacy and beauty of nature's geometrical designs as expressed in these tiny jewels of the air. The magnified photographs, enlarged about fifteen or twenty diameters, were obtained by the simple method of catching the falling snowflakes on a black screen, which could be immediately introduced on the stage of a low power miscroscope fitted with a photographic apparatus. In order to secure the best results the photographing of the snow crystals should be conducted in the open air while the snow is falling. Snow crystals have, for many years past, been successfully photographed and studied by Mr. W. A. Bentley, of Jericho, Vermont, and the photographs here reproduced have been selected from his extensive collection.

As a basis for art motives, it would seem that the range of uses to which these natural geometric forms could be applied is fairly comprehensive. Many of them suggest designs for cut and engraved glass in a great variety of applications. The stellate types, repeated with their extremities in contact, or nearly in contact, develop into allover patterns applicable to book covers, oilcloth, wall paper, or textile designs. Some of the more delicately branching forms are strongly suggestive of jewelry designs, as applied to brooches and pendants, either as settings for stones or enameled. The designer of stained glass rose windows may find in some of the compound tabular forms inspiration for unique patterns.

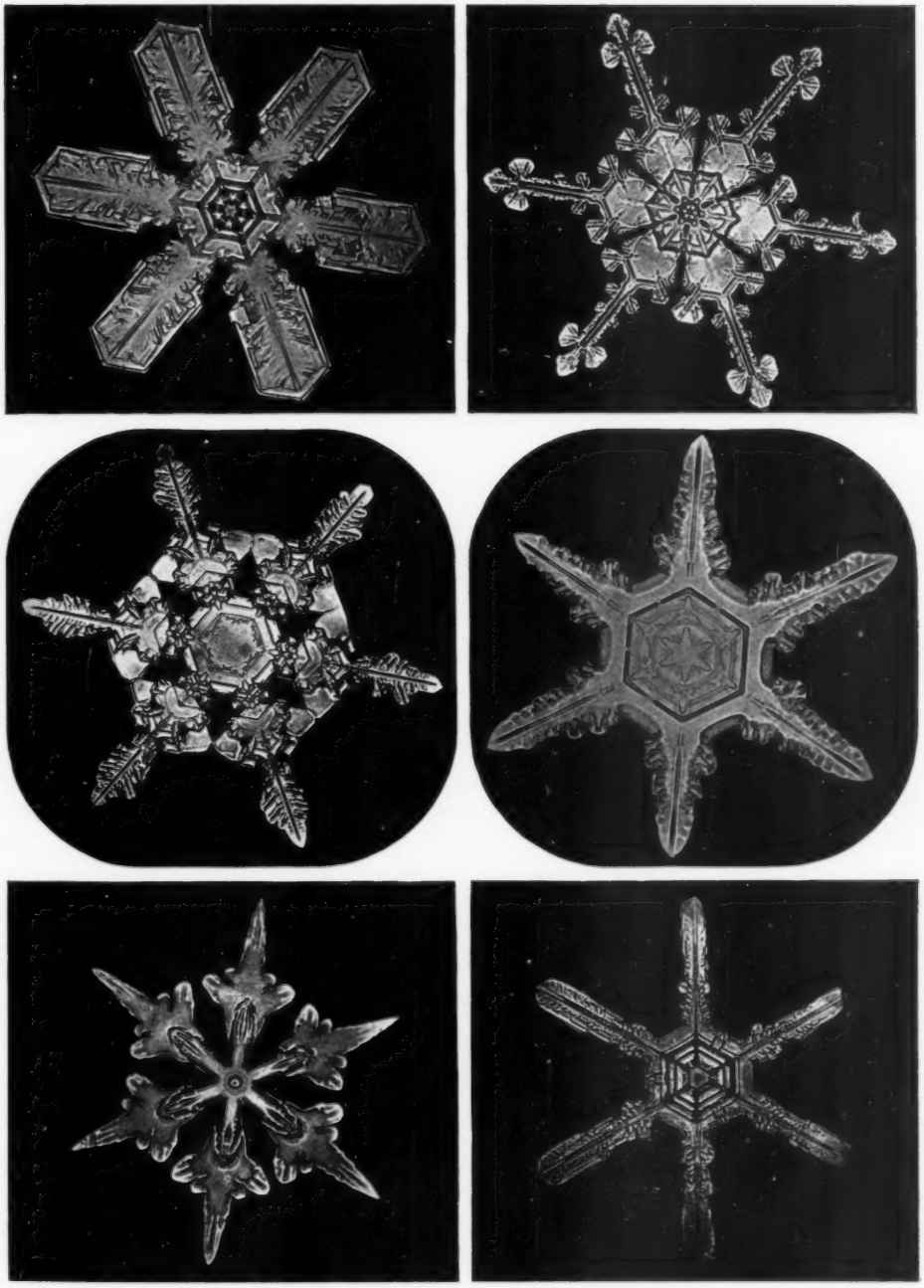
Lace and drawn work, rosettes in fresco, tailpieces for books and magazines, and medallions for the centers of china plates, are some of the suggested uses which might be made of snow crystal motives. In fact the user of geometric designs in any of the decorative arts could well profit by the consideration of these varied and beautiful combinations of six-sided symmetry turned out of nature's studio.

Nor is there any limit to the supply of new motives, derivable from this source. With every fall of snow, in temperate and boreal regions, under the right conditions, more combinations are being added to the thousands already photographed, constituting an ever growing portfolio of designs, and presenting every degree of complexity from a simple hexagonal outline to intricate, branching forms of the compound stellate type.



TABULAR DESIGNS FOR CUT AND ETCHED GLASS

The simple variations of the hexagon shown in this group of snow crystals suggest designs which could be used for cut and etched glass as applied to electroliers, bowls, and table glass. They could also be used as the centers of designs for china decoration in raised gold or color. These types of crystals are probably formed in relatively high temperatures and are found especially in local storms.



STELLATE SNOW CRYSTALS SUGGESTIVE TO THE TEXTILE DESIGNER

This type suggests close repeated designs in oilcloth or the conventional wall paper as well as in textiles, such as print fabrics and heavy curtains. These six-pointed stars are apparently a combination of the tabular and stellate types. The small tabular hexagons acquire branches in their journey through the clouds and become otherwise modified by the varying temperature and atmospheric pressure strata through which they fall. The lower right-hand crystal is interesting as an illustration of the not infrequent change from a triangular to a hexagonal form or vice versa. The more elaborate forms of this group merge into such complete stellate designs as are shown on page 436, and are susceptible of similar gold and enamel applications

COMPOUND TABULAR SNOW CRYSTALS SUGGESTIVE OF WORK IN FRESCO AND STAINED GLASS

This group of very modified crystals would furnish admirable designs for isolated rosettes in fresco. They even suggest rose windows in stained glass and Saracenic lattice work. All of the above forms are but illustrative examples of the many thousands of microphotographs which Mr. W. A. Bentley has taken during the last thirty-five years in Jericho, Vermont, and from which an infinite number of artistic designs adapted to different purposes might be selected

Cinema-microscopy an Essential to Modern Science and Education

By CHARLES F. HERM

(Department of Physiology, American Museum of Natural History)

MANY subjects in the various branches of biology which are discussed in the modern textbook belong to a region of observation inaccessible to the general reader or student. They can be approached only by means of refined techniques applied to special objects not ordinarily available for practical study or demonstration. A knowledge of these subjects must, therefore, in most cases be acquired from textbooks in which illustrations take the place of the living object. Drawings or still pictures, however excellent, cannot always convey an accurate mental picture of the living object. It is extremely difficult for the most skillful technician to represent even in a carefully preserved specimen the exact appearance of the real object. The fixative and stain render the subjects in some measure more or less schematic and embody a considerable subjective element of interpretation.

The Cinematograph Faithful to Nature

The cinematograph, whatever its shortcomings, gives an absolutely faithful representation of what appears under the microscope or before its lens; it contains no subjective element save that involved in the focusing of the instrument, and hence conveys a true mental picture—a picture nearest to nature itself.

There is no field of endeavor in which the cinematograph has not been tried, proved, and accepted, with the result that it has become an essential aid. The biologist, particularly, has an immeasurable opportunity for the production of films to show biologic phenomena such as function in health and disease, the action of parasites, and the many activities relating to personal and public hygiene, especially as hardly anything has been done in cinematographic representation along these lines.

Cinematographs of this sort would undoubtedly be a most important adjunct to real educational effort. The arduous and wearisome method of study by memorizing textbooks can be materially moderated by the adaptation of the motion picture. These pictures can be arranged so logically, so clearly, and so free from puzzling questions that students can immediately absorb the most complicated subjects.

Cinema-microscopy is a great need of the future; many colleges and schools are eager to introduce its results in their class rooms because they realize that no other device equals it for conveying a lecture or experiment. But at present where and how are schools to get films of such a character—films on microscopical subjects, strictly educational, having technical qualities, and produced by specialists just as textbooks are written and edited by specialists?

Cinema-microscopy a Problem for Educational Institutions

The production of a film textbook of zoölogy, physiology, or botany which contains hundreds of short reels or subjects, scientifically correct, up to the highest standard of learning, correlating with the approved textbooks, has so far not been a commercial suc-

cess, due perhaps to the lack of specialists, the large expense involved, and certain limitations of the subject. The public undoubtedly is interested; the secondary schools and colleges would welcome aid of this kind and it remains for some large educational institutions to establish a micro-cinema laboratory for the production of such negatives.

The producer of such films, if he be well acquainted with the various branches of science, can devise interesting and original experiments to suit any stage of knowledge. He can vary the experiments so as to bring the pupil face to face with something which can never be illustrated by diagrams in a textbook. He can lead the pupil step by step, and the more deeply he plunges into the particular branch of science, the wider will be his scope in the portrayal of scientific phenomena by fascinating experiments.

Cinema-biology a Demonstrator of Vital Life Factors

Above all, the cinematograph gives the scientist an opportunity to illustrate at will and repeatedly the results of the laboratory experiments. In many colleges, in medical schools, and even in certain classes of high schools, it is important to demonstrate the living phenomena as closely as possible; sketches, wall charts, or still photographs do not show the different movements and the results of experiments; they do not show the technique of the experimenter or the accompanying reactions of the organism such as the beating of the heart, the circulation of the blood, and the acceleration of respiration.

But by means of the cinematograph the most delicate operation can be recorded and all its details reproduced with the utmost precision. At the same time this wonderful instrument will save many hours of tedious laboratory routine which could be used to far greater advantage in original research. On the other hand, cinematography will widen the teaching power of any single experiment or demonstration, and become the greatest of all teachers.

When an experiment is well executed and recorded on the film, and then shown to a large audience of students, each individual can follow it precisely and in all its details. By varying the rapidity of the exposure the cinematograph can quicken or retard the movements. As is easily understood, this possibility offers great advantage for demonstration.

Each film becomes a document representing a scientific truth, and from this record any number of copies can be reproduced for the different schools and colleges of the country. The demonstration by cinematograph possesses certain marked advantages over the laboratory experiment: it reaches simultaneously and equally a greater number of spectators; it enables the teacher to demonstrate an important fact leisurely and repeatedly; it permits the student to interrogate and thus accurately crystallize his deductions from the experiment.

A cinematographic apparatus for taking and exhibiting scientific motion pictures has been installed by the Faculties of Medicine in Paris, Lyons, Bordeaux, at the Pasteur Institute in Paris and Lille, and even in certain museums. Records of the many surgical techniques and biological processes necessitated by the great war have in this way not only been visually preserved but have also been actually used for disseminating the knowledge gained.

But the auditorium and the class room should not be the only places in which to exhibit scientific motion pictures; a corporation should be established through whose agency certain scientific subjects could be exhibited to the public. Every day there are hap-

CINEMAPHOTOGRAPHS OF THE LIVING CHICK EMBRYO AND OF ANASTOMOSING BLOOD VESSELS IN ITS CIRCULATION

Microcinematograph of a forty-eight-hour-old chick embryo, together with its vascular area dissected from the egg yolk. The embryo has been placed in a culture medium where it is kept alive for many hours while the rhythmical action of the heart and the circulation of the blood are photographed. This illustrates the possibilities of the motion-picture machine in reproducing physiological processes for educational purposes. The heart is seen in the embryo as an external bulblike organ near the center of the animal. The dark vessels are the vitelline arteries and their branches, while the lighter are the various branches of the venous system. Magnification 120 diameters

Connecting or anastomosed capillaries of the vascular area of the chick embryo magnified 500 diameters. The blood corpuscles are seen as disks which by means of the cinematograph can be shown floating in the blood serum through the system of microscopic capillaries. In this way experiments too complicated or difficult to be performed by the individual student and unsuited for demonstration from the lecture table can be presented to elementary classes in biology, whereas at present verbal description or still photographs and drawings are relied upon. From the cinematograph the student will get not only the facts but he will also have many of the advantages of the laboratory work

penings of interest and importance in the scientific world of which the people at large have only a hazy understanding. Scientists make discoveries which illumine the dark phenomena of ordinary life; inventors create new wonders for the benefit of mankind—but about all these things the people for whose benefit the creative mind of the scientist really works, know little or nothing. Many of these subjects could be rearranged so that they would be entertaining and at the same time would give the public the kind of picture which is instructive, which demonstrates vital factors in life.

Films Showing Circulation of Blood in the Chick Embryo

My interest in this work has arisen through laboratory researches on living tissue in the department of physiology at the American Museum of Natural History. In collaboration with Mr. Alessandro Fabbri, research associate in physiology in the American Museum, who is much interested in biological cinematography, there has been prepared a microscopical film 1200 feet long, on the physiology of the heart and the circulation of the blood in the chick embryo. This work was done in the private laboratory of Mr. Fabbri,—a laboratory completely equipped with all facilities for the highest grade of cinematography.

The physiology of the heart and the circulation of the blood have attracted the attention of investigators from very early times. Far back in 1616 scientists studied them. William Harvey was the first to grasp the fact that the heart acted as a force pump to drive the blood in a circle through the blood vessels and back. Since the time of Harvey, however, physiological technique has been remarkably improved. Many methods have been discovered to demonstrate the general function of the heart and vascular system. But not until cinema-microscopy attracted the attention of modern physiologists, has it been possible publicly to demonstrate the finer details of this phenomenon.

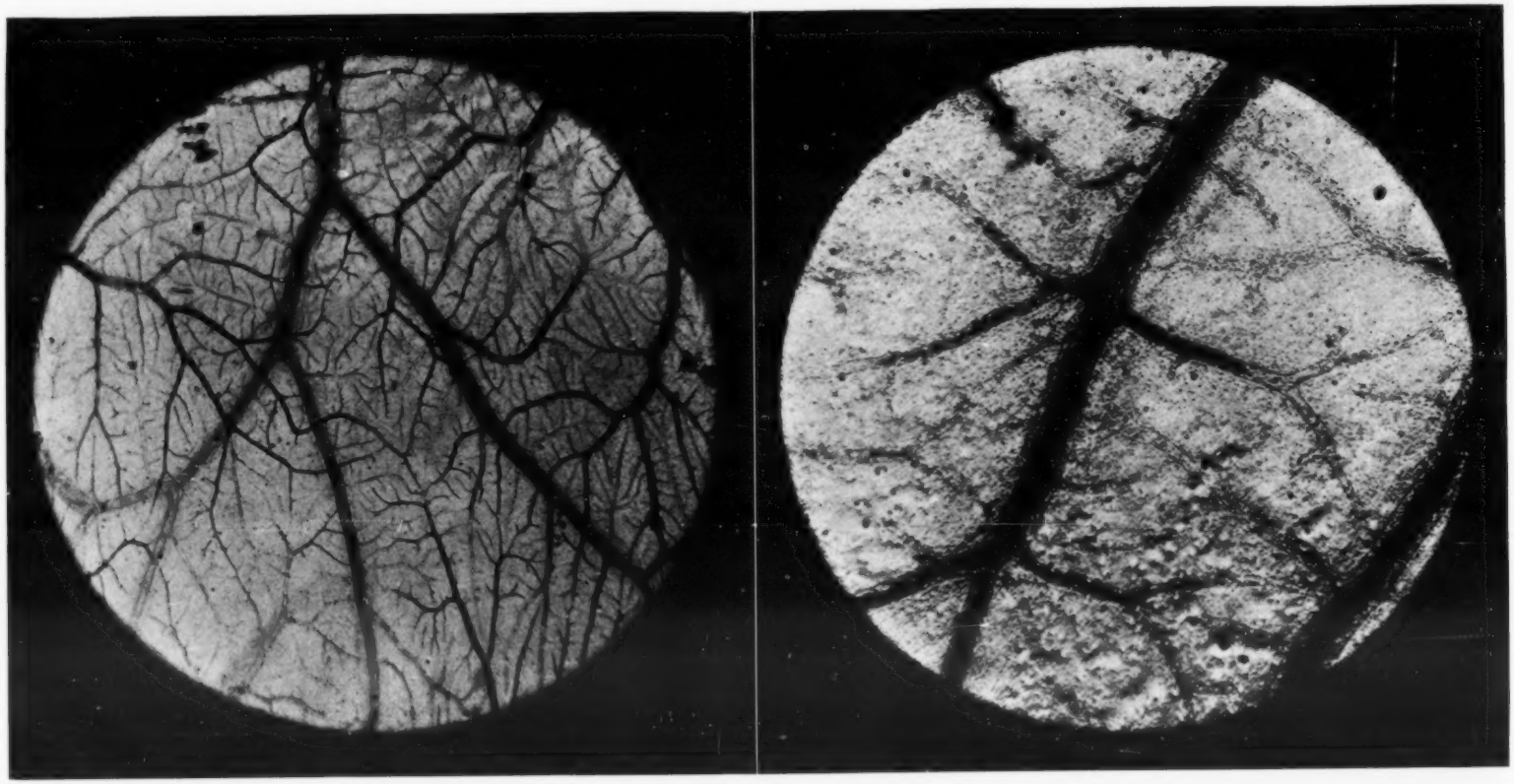
In the film which has been made, the first scene demonstrates the necessity of carefully marking on the shell of the egg the date and hour when it is placed in the laboratory incubator, in order to obtain an embryo of known age. A constant temperature of 103 degrees Fahrenheit is maintained.

The second illustrates how, after forty-eight hours, the egg is removed from the incubator and, after being carefully opened, is placed in a glass dish, embryo and vascular area uppermost. The vascular area, with its embryo, is now dissected from the yolk and transferred to a large culture chamber, which is sealed with a cover glass by means of hot paraffin and placed under the micro-cinematographic apparatus.

We see the entire living embryo, forty-eight hours old, demonstrating the circulation in the vascular area. The circulatory system of the young chick consists of branching tubes, the arteries coming from the heart, which is now outside of the body. Dividing into a fine network of capillaries in the vascular area, these vessels reunite into a large vein which carries the blood back to the heart at the opposite side.

The picture shows the heart as a muscular organ which rhythmically contracts, decreasing its volume, and thereby driving out the blood which has flowed into it during the period of relaxation. In mammals and birds there are two separate circulations; the two pumps are combined side by side, the right auricle and ventricle form one pump, while the left auricle and ventricle form the other.

The subject of the fourth scene is the heart of a living embryo thirty-three hours old, showing its first rhythmical activity and the course of the blood in the transparent heart cavity during contraction.



CINEMAPHOTOGRAPHS OF BLOOD VESSELS WHICH CARRY THE FOOD SUPPLY FROM THE YOLK TO THE DEVELOPING CHICK EMBRYO

The capillary network of the yolk sac is here shown in detail, demonstrating the ultimate connection between the arterial and venous systems as well as the free endings of many of the capillary tubes. With the cinematograph this fundamental aspect in the circulation of the blood can be presented not only to the student of embryology with his incubators and expensive laboratory equipment, but also to the elementary classes in physiology and zoölogy. It requires, however, production of films by specialists and not merely by professional photographers with no particular knowledge of the science they are to demonstrate

Capillary tubes from the yolk sac of the chick, magnified 200 diameters, showing the free endings of some of the branches. It is by these fine tubes that the food material stored in the egg is absorbed by the growing embryo. Physiological actions such as the above can be recorded and indefinitely repeated in the class room, together with the technique of the experimenter or the surgeon. In this way the teaching power of any particular specialist is widened, and the audience to which scientific knowledge may be brought is enlarged

The next picture shows us a heart of a living embryo thirty-six hours old, with body still transparent enough to demonstrate the action of the heart valves. In the following picture we see an embryo magnified 150 times, and we observe the circulation of the blood in the right and left mesenteric artery and the contraction of its walls. Next the vascular area is seen in detail where the blood vessels, as they become farther removed from the embryo, divide into smaller branches, and there is evidence that an increased internal friction results which causes considerable resistance to the flow of the blood. A high pressure is therefore required in the main arteries to drive the blood through the small vessels. Next we see the mesenteric artery demonstrating the arterial flow of blood; we follow the blood vessel until it divides into several branches, which in turn are often connected by anastomosis; then the arterioles in fore- and mid-brain and the capillaries in the hind-brain; then we see the capillaries of the posterior vitelline area, the posterior cardinal vein, the capillaries of the anterior vitelline vein, all leading back to the mesenteric venous system and reaching the embryo again at the right mesenteric vein, where the even flow of venous blood is nicely demonstrated.

Another film has also been constructed in collaboration with Mr. Fabbri, emphasizing the behavior of transplanted heart muscle. Many experiments have been made in transplanting heart muscles into a tissue culture to determine the conditions which will prolong their life and function. The heart of a chick embryo will beat rhythmically from six to ten days after having been removed from the animal and transplanted in blood plasma. But if tissues are retransplanted from time to time into a fresh culture, it is known that the muscles will live for more than sixty days.

In order to obtain such cultures for the motion picture the heart of an embryo is dissected into small pieces about the size of the head of a pin, and each piece transferred to a cover glass and quickly imbedded in a drop of blood plasma. The cover glass is then inverted over a hollow ground slide and sealed with hot paraffin to prevent drying; the prepared slide is then reincubated.

In the picture we see the transplanted heart of an embryo eight days old, which is still beating rhythmically after six days of transplantation; also a section of heart muscle fifty times magnified showing its rhythmical activity ten days after transplantation.

Scientific authorities agree that one of the most valuable possibilities of such films lies in the fact that they bring within the comprehension of the student mind a wide range of information, thereby encouraging reflection, original thought, and research.

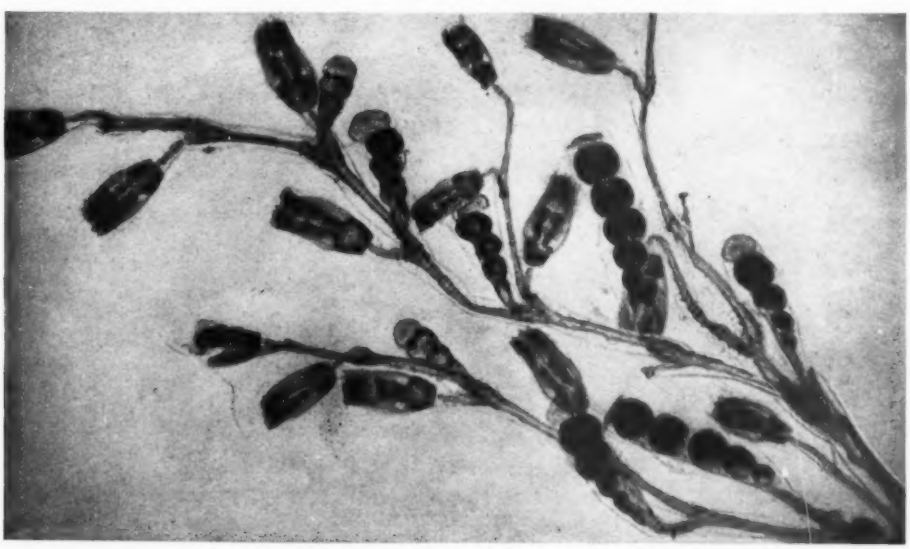
The cinematographic apparatus used for the production of these films is a special and rigid table, and a Debri camera. The source of light should be automatic, as it otherwise would be difficult to keep a subject properly illuminated for a certain length of time. The condenser and cooling trough are attached in front of the arc, between the microscope and the light. The vertically arranged camera has attached to it a handle by which it can also be swung in a horizontal position when detached from the microscope. This camera is provided with a direct focus tube through which the image on the film can be watched during exposure. This arrangement is of extraordinary importance, because it is absolutely necessary to watch the living subject while under the camera in order to obtain the best pictures. The mechanism for moving the film is worked by a small electric motor which is connected by pulleys and a leather belt to the shaft of the camera. The micro-

scope used is a Zeiss No. 1. This instrument is of excellent construction and is supplied with an Abbé condenser, a dark-field illuminator, and a special rotating and centering mechanical stage with very slow movements for micro-cinematography; but the ordinary stage is preferable for most of the work. Here the vertical movement is built into the stage and the bar carrying the lateral movement is removable. The substage is focused by rack and pinion, but does not carry centering screw. The Berger fine adjustment is a very practical arrangement fitted with lateral milled heads. The body tube is 50 mm. wide. The diameter of the body tube is quite important for cinematographic purposes, for in working without eyepiece it governs the area of the projected disk and, within the covering power of the objective, the size of the specimen that is to be photographed. The ordinary microscopes generally carry a tube 37 mm. in diameter, but for the reasons just mentioned, a 50 mm. tube is much to be preferred. To utilize the wide tube to full advantage arrangements must be made for the removal of the draw tube. The interior of the tubes must be dead black, so as not to cause reflections.

The most difficult problem in cinema-microscopy is the illumination. Sunlight would be ideal for the purpose, but because of the uncertainties of its availability recourse must be had to artificial lights, of which the electric arc lamp is the most useful.

Arc lamps are made to work with almost any current, direct or alternating, from 4 to 60 amperes or upward, giving a light that varies correspondingly from 300 to 10,000 candle power. The most useful lamps for the purpose under consideration are the smaller types taking 10 amperes or less.

The Bausch and Lomb 10-ampere lamp is very well adapted for cinema-microscopy. It is a hand-fed arc rendering about 1500 candle power; the carbons are regulated by milled heads which work very smoothly, and despite constant attention necessary to keep the arc in reliable working condition, this lamp has proved perfectly satisfactory. The arc is adjustable to different heights on a suitable pillar, and can be tilted if required.



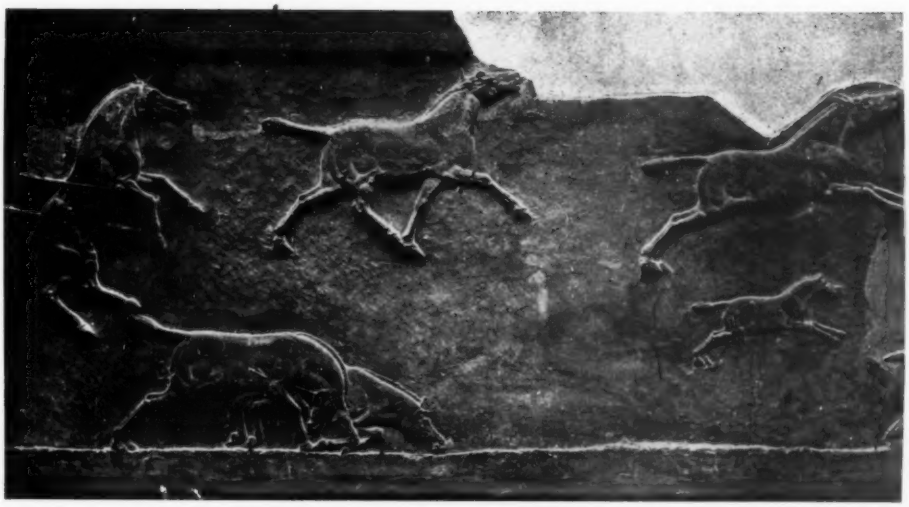
Microphotograph of a hydroid, *Gonothyræa* (enlargement about 100 diameters), showing growth in branching colonies, also two kinds of members of the colony, feeding polyps (flower-like in appearance) and reproduction polyps

A MASTERPIECE OF ASSYRIAN LOW RELIEF

This and the examples of Assyrian sculpture following, from copyrighted photographs of the originals in the British Museum, are reproduced through the courtesy of W. A. Mansell & Co., of London

The foundation for low relief was laid from twenty to thirty thousand years or more ago, before historic times, in southern France, by the Crô-Magnon race. Their sculptures on the walls of caves, in low or in high relief, or in drawings incised or painted, challenge our admiration today by firmness of touch and sureness of line, and by what some of us in this twentieth century A.D. should take to heart—the restraint which cautions against unnecessary detail.

Low relief in relation to architecture had its foundation in early historic times as a development in Egyptian art. Egyptians discovered that conventionalism and simplicity even to the extent of stiffness of the lines and figures brought harmony of the sculpture with the building. They, however, did not use animal sculpture to a great extent, whereas the Assyrians did; therefore, the direct line of tradition of architectonic principles in animal sculpture comes to us by way of the Assyrians—for instance, through the beautiful sculptured friezes of Nineveh. The above low relief of the head of a horse is a masterpiece in which accuracy of drawing is combined with simplicity of modeling



A group of wild asses from the Palace of Nineveh

Zoölogical Sculpture in Relation to Architecture

With especial reference to development from the Crô-Magnons through Egypt, Assyria, Greece, Rome, and France.—Whether in high or low relief or in the round, the posture as well as the planes, the lights and the shades, should carry the lines of the architecture.—A vast future for modern architecture lies in the lessons of the past on animal sculpture

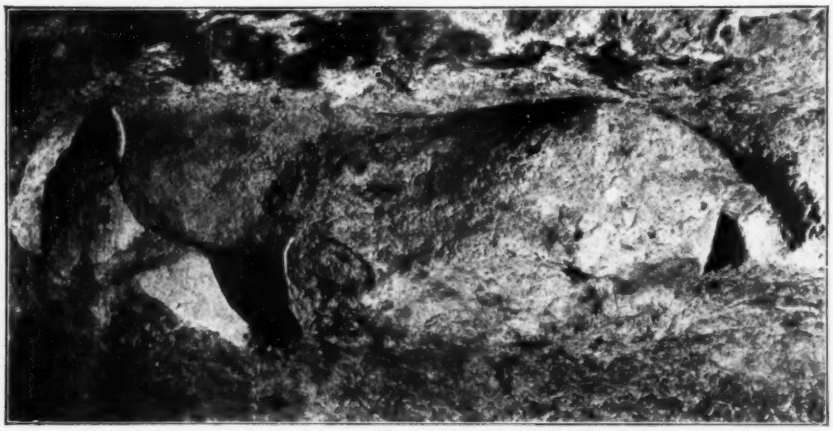
By S. BRECK PARKMAN TROWBRIDGE[1]

THE recent discovery of animal paintings and sculptures on the walls of the caverns in southwestern France and the Pyrenees writes the prologue of the history of art and at the same time makes an important contribution to the science of zoölogy.

These works of art, executed in the Aurignacian and Magdalenian periods, that is, about twenty or thirty thousand years ago, give striking evidence of the high state of intellectual development of the Crô-Magnon race to whom their creation is attributed. Their value to science consists in the truthful and accurate representation of a great number of animals, some of them long since extinct in Europe, such as the mammoth, the horse, the cave bear, the wolf, the reindeer, the rhinoceros, and especially the bison, whose majestic and imposing form seems particularly to have appealed to the fancy of the artists. Their artistic qualities challenge unqualified admiration. Paintings, incised drawings, sculptures in low or in high relief abound, and all are characterized by firmness of touch, sureness of line, and by admirable restraint in the omission of unnecessary detail.

Prehistoric sculpture had for its background the bold and rugged rock walls of the caverns and shelters, and never erred in too great refinement of

[1]Appointed by Roosevelt when he was President, as chairman of the National Council of Fine Arts; incorporator, vice president, and trustee American Academy in Rome; member Trowbridge and Livingston, Architects, New York City.

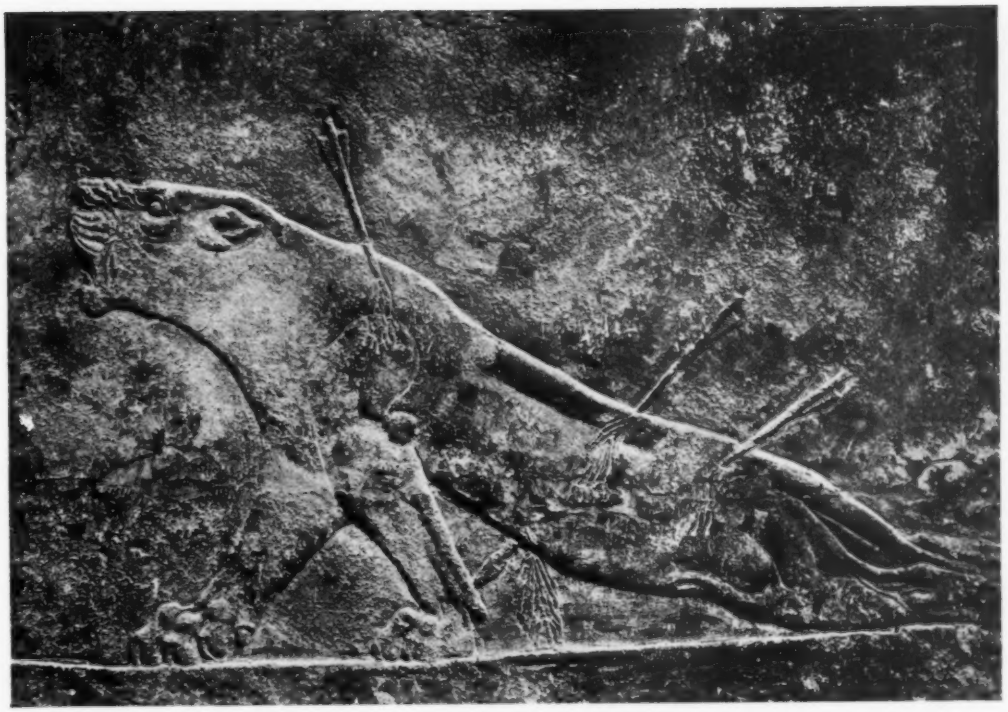


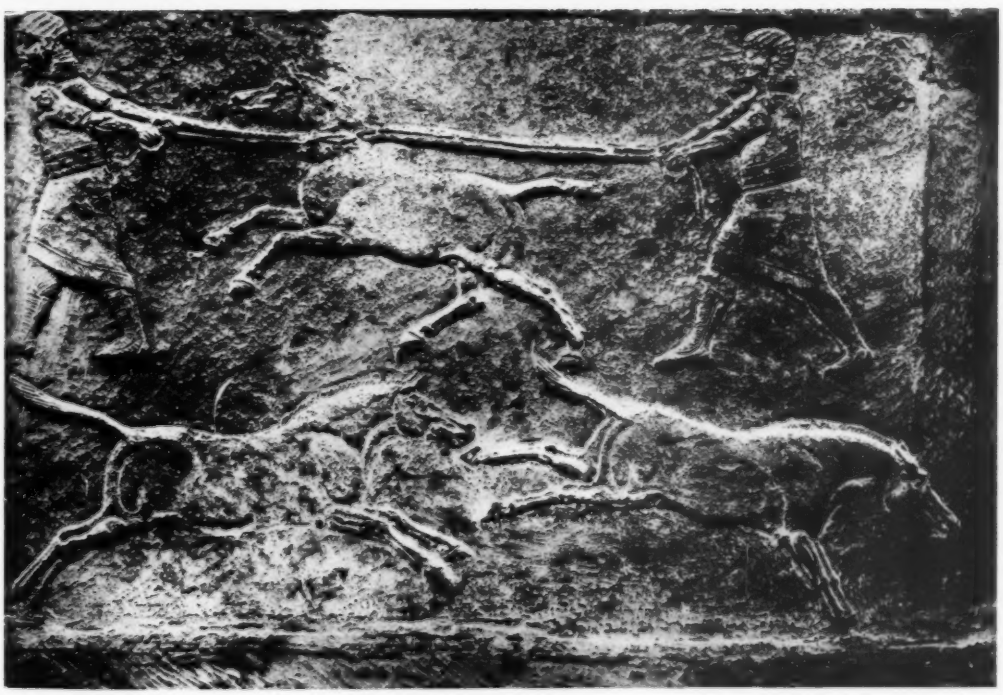
From "Men of the Old Stone Age" through courtesy of the Author and Charles Scribner's Sons

Part of a frieze of six horses, each horse relief seven feet long, found sculptured in the limestone under the sheltering cliff at Cap-Blanc (in Dordogne, France). Crô-Magnon artists invented low relief—a conventional method of representation of the round in a series of very flat planes by a proportionate reduction of thickness. Their subjects were many European animals now extinct, especial predilection being shown for mammoth, bison, reindeer, and wild horse. To view their work today, in comparison with modern sculpture, is to recognize the "unity of purpose, the sincerity, the restraint, the appreciation of plane and shadow combined with truthful and accurate delineation," which place it not as an effort of savages but as a work of true art by a highly developed human race

From "Men of the Old Stone Age" through courtesy of the Author and Charles Scribner's Sons

From the Crô-Magnon painting of the Celtic horse from the ceiling of Altamira, in northern Spain. This ceiling of ancient paintings, now so famous throughout the world, was discovered in 1879 by the little daughter of the Spanish archæologist, Sautuola, who was hunting flints on the cavern floor. The paintings are polychromes, ochreous brown in color, the outlines etched in the stone, given strong contour lines in black, and often a second series in red. On the Altamira ceiling the paintings are placed in groups, often on bosses of the limestone, the Crô-Magnon artist having had sufficient creative genius thus to adapt his work to the surface of the rock. (This painting of the Celtic horse may be seen in color as a mural in the American Museum and is reproduced in color in the *American Museum Journal* for December, 1912, in connection with articles by Professor H. F. Osborn and Dr. Clark Wissler)



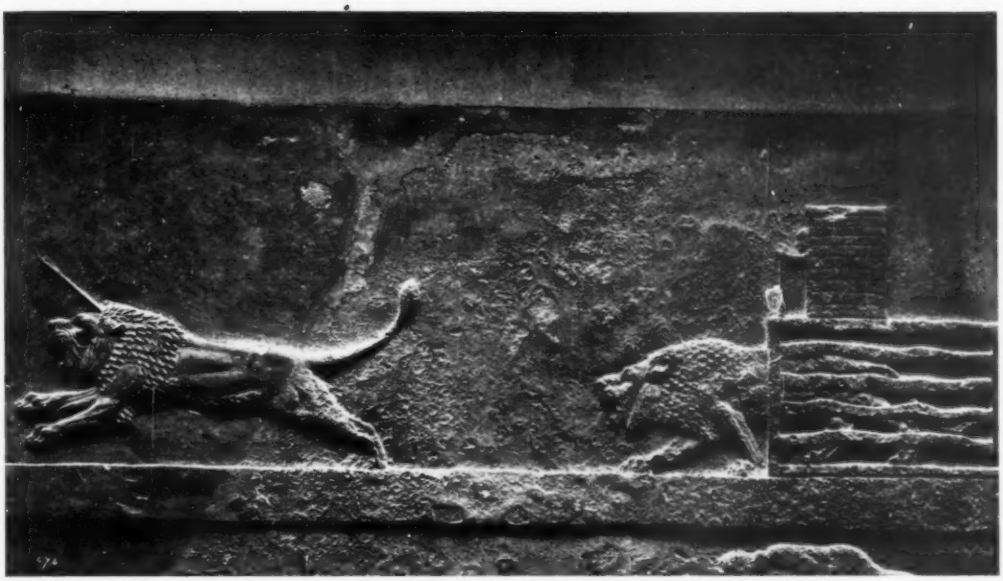


(Above) The Wounded Lioness from Nineveh—This Assyrian relief is remarkable not only for truthful drawing and modeling but for the suppression of every unnecessary detail and the emphasis of every part necessary to the impression of unbeaten courage which the artist wished to convey

(Below) A beautifully composed group of wild asses from the frieze of Nineveh. Compare the drawing of the heads of these animals with the sculptured Crô-Magnon horse on the opposite page

Part of a frieze in the Palace of Nineveh, the groups of which are conspicuous for their excellence in composition. Among the Assyrians we find first in historic times animal sculpture as such. Their work proves that they had love and knowledge of animal life and that they sought to express the characters of the wild beasts. Assyrian sculptures followed rather closely in artistic quality the cave sculptures of Crô-Magnon man, notwithstanding 15,000 or more years' separation in time and the entire lack of knowledge of the early artists among the Assyrians

Another group from the frieze in the Palace of Nineveh. Here at least six planes of surface are expressed in the slight projection. No country has ever equaled Assyria in the amount of animal sculpture used as a decorative feature in building, although to the Greeks belongs the credit of bringing such work to its highest expression



Lions from the same Nineveh frieze. The conventional treatment of the mane recalls the cuneiform inscriptions. The spirit of conventionalism in Assyrian sculpture connected with architecture passed on as a heritage to mediæval architecture, but the development there entered the field of human figure representation

All the figures of this frieze, in their treatment of detail, show very distinct architectonic qualities in that they harmonize perfectly with their architectural setting

A BEAUTIFULLY COMPOSED GROUP OF WILD GOATS FROM NINEVEH

A GROUP OF WILD ASSES FROM NINEVEH

The figure of the ass looking back over his shoulder is one of the most extraordinary reliefs in existence, not only on account of its drawing and modeling, but because the full depth necessary for the turning of the head is expressed without violating the plane of the picture

detail. Whether in flat or low relief or whether in bold relief, as in the case of a frieze of six horses, each seven feet long, carved on the wall of the rock shelter at Cap-Blanc, on the River Beune in Dordogne, these sculptures always show the unity of purpose, the sincerity, the restraint, the appreciation of plane and shadow combined with truthful and accurate delineation, which characterize all the work of the Crô-Magnon artists and place them not among the primitive efforts of savages but in the realm of true art.

It is a far cry from the Magdalenian art to that of the present day; but one cannot look upon the former without feeling that both are inspired by the same impulse and that underlying both are the same basic principles, so that we may justly attribute to the Crô-Magnon race the inauguration of the great traditions of art which have come down to us through the ages.

After a long gap of approximately fifteen thousand years, sterile in art as far as our knowledge goes, we come into the more familiar ground of historic times. As the architecture of Egypt developed and finally crystallized into a definite style, sculptural decoration necessarily followed the general trend and became highly conventionalized.

In order to produce unity, harmony of line, of surface, and of light and shadow in their architecture, Egyptian artists discovered that in their sculpture simplicity of modeling, firmness of outline and restfulness, even stiffness of pose, were essential, and to them we owe the tradition of those architectonic qualities which are so necessary to make of sculpture an integral part of a building.

Although there are many very beautiful examples of animal sculpture in Egypt, they are generally found grouped with human figures, and are more or less subordinate or incidental to the scenes presented. In Assyria, however, we find once again after many thousand years a return to the use of animals as the principal motive of wall decoration. Like their forerunners of Magdalenian times, love and knowledge of nature led the Assyrian artists to express the emotions and characters of the wild beasts. With no possibility of any knowledge of even the existence of the earlier art and with a separation of about fifteen thousand years between them, it is interesting to note how closely in artistic quality, in the essence of characterization, the Assyrian sculptures resemble the Crô-Magnon.

The lion hunt from the palace in Nineveh is but one of many groups adorning the palace walls which display not only great artistic quality in the individual figures but also a very marked ability in composition as well; and "the wounded lioness," one of these individual sculptures, is one of the most exquisite sculptures in existence, in which sincerity and simplicity are the salient characteristics and which, as an expression of unbroken courage and unconquered spirit, is unrivaled. All these animal figures are necessarily stylized, or conventionalized to the degree necessary to conform to the architectural setting, but in artistic feeling and in technique, as well as in truthful interpretation, they are unsurpassed.

As in Egypt conventionalism made possible the depiction of mythological forms such as the gryphon and the sphinx, so in Assyrian caryatid figures, where required for the portals of the palace, conventionalism permitted the use of the great bulls with human heads. In the use of animal sculpture as a decorative feature of architecture, no country has equaled Assyria.

Another recent discovery has added one more chapter to the history of art and illustrates again the principles laid down by our Crô-Magnon forerunners. No enumeration of the great animal sculptures of the past would be com-

plete without at least a mention of the sculptured bulls of Crete.

To find, however, the highest expression of architectural animal sculpture we must, of course, turn to Greece. As the Parthenon has no equal in its architectural perfection, so the sculpture which adorns it is unparalleled in its beauty. As we should expect, there is a perfect blending of architectural and sculptural detail. The frieze depicting the Procession from Eleusis at the Panathenaic Festival, with its long line of horsemen, is a perfect illustration of the application of the principle of architectonic sculpture. The horses and men are rendered in low relief, vigorous and clean in line and contour, simple in modeling, restrained in detail, conventional to just the right point, and the proportionate relief of the different parts is preserved without confusion or the loss of a necessary shadow.

The posture of each figure, particularly the horses, though all are supposed to be in motion, is at that point of momentary rest which indicates the completion of one movement and the beginning of the next, giving

Detail from the Panathenaic Procession of the Parthenon Frieze.—Among the Greeks, architectonic sculpture reached its highest development. The frieze of which this is a small part is perfect in composition, posture, drawing, and modeling, and eight distinct planes are shown without confusion

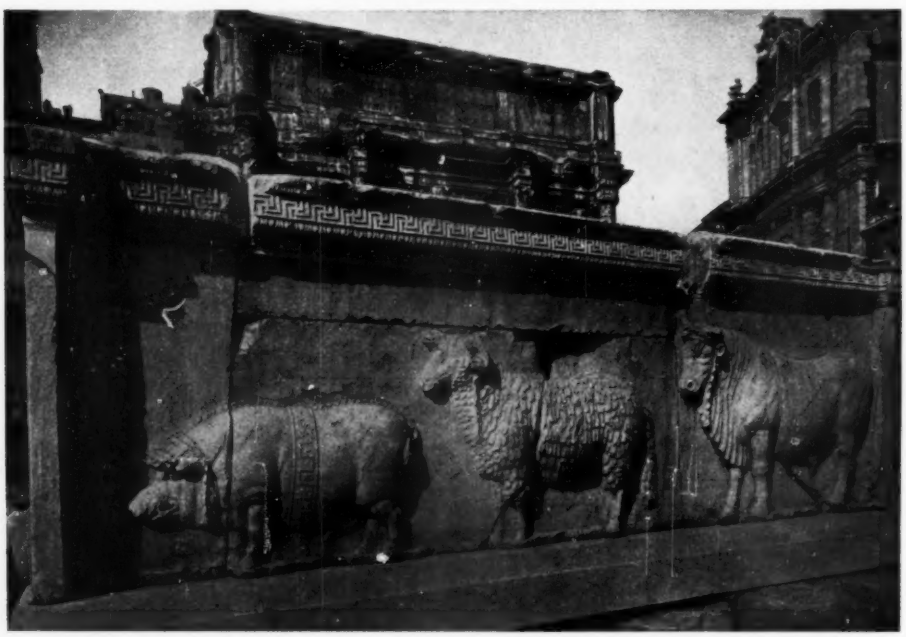
the impression of progress to the whole procession without violating the canon that the medium of sculpture precludes the translation of actual movement.

The later Greek sculpture fell gradually into a realism which marked its decadence. Rome, however, revived to some extent the early Greek spirit and produced some notable animal sculpture. The very beautiful relief which adorns the rostra in the Roman Forum, as a single example, is sufficient to show that the Roman artists were still influenced by the early Greek spirit, and understood the necessity of conventionalism in architectural sculpture.

Mediæval architecture, although abounding in sculpture, has little to offer in the representation of animals if we except the grotesques, but in the use of the human figure it is unsurpassed and teaches a wonderful lesson in architectonic ornament.

Quite different in character but equal to the Greek sculpture in its adaptation to the lines of its architectural setting, Gothic figure sculpture, aided by the use of lines of draperies, not only melts into and blends with the mass and the detail of the building, but in the cathedrals and churches is also the means of proclaiming the spiritual and religious feeling of the architecture. The very rigidity of the figures, carried sometimes even to the point of awkwardness, typifies the mysticism and religious fervor of the age. Nothing could better illustrate the meaning of the "architectonic quality" than the portals of the great French cathedrals. The pose of the figures, the lines of the draperies, the quality of the modeling, the introduction of the crocket-like figures in the arches, all harmonize with and are a part of the architecture.

The saints of the portal of the Cathedral of Notre Dame in Paris (see Frontispiece) when seen apart appear grotesque, stiff, and uncouth, but in their proper setting, with the straight lines carrying up the vertical lines of the



Rostra, in the Forum of Rome.—The treatment differs materially from that in the Parthenon frieze. Harmony with the architecture has been preserved, but a decline in the art of relief is noticeable in that there is an attempt to produce the actual roundness of the figures, violating the essential principle of low relief

architecture, and with the wonderful adaptation of planes and angles, they are the very acme of architectonic art. It is impossible to imagine these figures in a Greek temple or the frieze of the Parthenon on a Gothic church, yet each in its proper place is as near perfection as the art of man has been able to attain. In later Gothic times the tendency to realism again marked a decline and a decadence; as sculpture became more perfect in the imitation of nature it lost in architectonic quality and, as a result, in power of expression.

The Renaissance, in which one may include our own times, has given few great examples of animal sculpture as applied to architecture. For three hundred years sculpture has shown a tendency to fall more and more into realism with a resultant loss of architectural value. The history of art has been marked both in painting and sculpture by a succession of alternate waves of simplicity and complicated realism. We seem now to be coming to the end of a phase of the latter and there are unmistakable signs of a reaction.

A number of schools of various degrees of extravagance have appeared, the cubists and the modernists, but in passing they have rendered an undoubted service. They have at least notified the world that art is not photographic imitation, and they have broken the spell which seems to have bound us for nearly three centuries—but they, like children groping in the dark, have not found the way. Whether through deficient education or through lack of reasoning power, they have tried to persuade the world that artistic expression can be reached without work, that accuracy and skill in delineation are unnecessary or harmful; whereas the exact contrary is true.

The whole experience of mankind, the whole history of art from the Crô-Magnons to this day, teaches that there is no short cut, that there is no easiest way. Work, hard work, through years of incessant effort, is necessary to produce the qualities which enable men to express great and noble thoughts through the medium of dead immutable materials.

The error into which we have fallen and that into which the modern schools would lead us are the same. In both cases it is due to the neglect of the great tradition which has come down to us in an unbroken line from the Crô-Magnons, through Egypt, Assyria, Greece, Rome, and France, that, in the art of sculpture, as in all art, there must be sincerity and truth, accuracy in delineation and fidelity in modeling, and the suppression of every detail unnecessary to expression. The quality of beauty, which is the very essence of art, implies that the subject should always appeal to the higher and not to the baser emotions.

Where sculpture, whether of men or animals, is used in architecture, the treatment should be architectonic in order that it may be an integral part of the building. Whether in high or low relief or in the round, the posture as well as the planes, the lights and the shades, should carry the lines of the architecture. These are the lessons of the past. The ability to carry them out depends upon great technical skill, which can be reached only by infinite pains and a lifetime of labor and study.

Advocates of new styles in architecture who are constantly crying for new motives might do well to consider the possibilities of animal sculpture. There is a peculiar charm, an appealing pathos, in the expression of human emotions through the medium of the dumb animals, and by an endless variety of forms nature has provided a fertile field for the imagination. As far back as the Old Stone Age art sought its inspiration in the forests and plains and left traditions of interpretation which experience has shown cannot be neglected with impunity.

ON VIEW AT THE FIRST EXHIBITION OF ANIMAL PAINTING AND SCULPTURE IN THIS COUNTRY

This bronze, the black rhinoceros with tick birds on its back, was modeled by James L. Clark in 1914 shortly after his return from a trip with A. Radclyffe Dugmore to Africa, where they followed the big game over the African plains and obtained a famous collection of photographs. Mr. Clark has studied his animals in the field at close range and is interested in them as individuals. He shows in the arrangement of his subjects a familiarity with their inner psychology as well as with their external anatomy. The love of the animal for its own sake marks the true animal painter or sculptor. This rhinoceros bronze (which stands about two feet high) takes on additional interest because it is a duplicate of one which formed the centerpiece on the library table of the late Colonel Roosevelt's trophy room at Oyster Bay

By Grace Mott Johnson

Wild Life in Art

WORK OF CONTEMPORARY AMERICAN ARTISTS IN SCULPTURE, PAINTING, AND BLACK AND WHITE, DEALING WITH ANIMAL LIFE

By CHARLES R. KNIGHT

Illustrations from the work of Carl Rungius, James L. Clark, Charles Livingston Bull, Carl E. Akeley, and others[1]

TO the Brooklyn Museum belongs the credit of holding what is probably the first exhibition of animal painting and sculpture in this country. By this I mean an exhibit shown in a picture gallery and therefore regarded by artists and laymen as a true art expression along the lines selected by the sculptors and painters who took part in it. The purpose of those who had the exhibition in charge was to include

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NOTE.—That our country is young and has, to date, been developing commercially rather than in the arts is evidenced in the lack of local encouragement of art. We have great centers like New York City where the painter or sculptor is recognized, finds some small chance for study, inspiration from the attitude of the people to do the best that is in him, and also the very necessary commercial market for his canvases or bronzes. But there is an emphatically disadvantageous situation in this country as a whole for the artist—perhaps particularly for the animal artist.

A young artist in America has to go to a great art center like New York to sell his work. His townspeople in the West, or the South, or the North, would seldom think of buying it, or even of holding him in the high esteem his work deserves. As a people we are not yet educated to it. The only art seen in many places is by means of the circuit system of sending pictures from city to city, and these of course do not reach the small towns.

Even in New York an artist must hire a place himself if he wishes his work exhibited. The American

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[1] For examples of the animal sculptures of A. Phimister Proctor the reader is referred to pp. 470–476 of this magazine; for further illustrations of the work of Carl E. Akeley, to the AMERICAN MUSEUM JOURNAL for April, 1913, pp. 172–178, and May, 1914, pp. 175–187; for that of Louis Agassiz Fuertes to the JOURNAL for May, 1915, pp. 220–224; and the work of Charles R. Knight is illustrated in the JOURNAL for March, 1914, pp. 82–98. We regret that we have not been able to give a reproduction of Bruce Horsfall's "California Condor" or other of his notable canvases

Miss Grace Mott Johnson approaches the study of large game animals purely as a sculptor. Her elephants are studio models rather than wild life, but modeled with a suggestion of movement and force. She follows an interesting insistence on the planes of the muscular surfaces

works having both decorative and realistic character, with the result that many different styles of design were presented at the same time. This seems to me a very excellent idea, my only regret being that the necessarily limited space forbade the assembling of a still larger and more comprehensive exhibit. It was with much pleasure, therefore, that I was privileged to spend several hours wandering about the alcoves set apart for the purpose.

On first entering the main hall a bronze statuette of a rhinoceros caught my eye. This is the work of James L. Clark, at one time connected with the American Museum of Natural History. Mr. Clark made this model, which represents a black rhinoceros with several small tick birds on its back, shortly after his return from a collecting trip in Africa in 1913. The character of the great beast is very well expressed and one is impressed by the fact that Mr. Clark loves animals for their own sake and strives to depict not merely their outer form, but their inner psychology as well. This is a most important point and always marks the true animal painter or sculptor as the case may be. Miss Grace Johnson, on the other hand, to judge by her models such as those of elephants and lions has evidently studied modeling in the schools, as her work shows an insistence on the planes of the muscular

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art museum seldom holds an exhibition of the work of American artists, except perhaps of such men as Whistler and Sargent. It buys mostly foreign pictures or bronzes, yet—and here is the crux of the whole matter of comparison of conditions in America and Europe—not many European paintings or bronzes and never any European wild life art is seen for sale in America, because if there is any cleverness in that kind of work in Europe, it is kept in the particular home town of the artist as a special possession. In Europe artists do not have to flock to the great centers to find encouragement or market for their work. In France and various other European countries there are many art galleries scattered in many towns, and there is a well developed general appreciation of art by the people.

It will take time to educate ourselves to a similar spirit in America, but this is what we must accomplish if art in America is to become at all comparable with art in Europe. Can we doubt that obligation —responsibility for the result—rests upon the great centers, especially upon New York?—C. R. KNIGHT.

The famous bronze, "The Wounded Comrade," represents two elephants assisting a wounded bull to a place of safety. It is perhaps Mr. Carl E. Akeley's best known group. The subject of the bronze and its sympathetic treatment make a strong emotional appeal. Mr. Akeley, noted as a hunter of African elephants, has studied intimately the animals he portrays, and he gives to his sculptures the true form and character of wilderness life, which animals living in captivity do not possess. (An illustrated description of the clay model of "The Wounded Comrade" appeared in the JOURNAL for April, 1913)

"Children of the Sage," a canvas showing the pronghorn antelopes in their wilderness home, by Carl Rungius. The artist is a hunter and traveler who has lived much among the western game, painting the animals as he found them in their natural surroundings. This picture sets forth well the life of the pronghorn antelope, one of our most graceful ruminants and once the commonest large animal of the Plains. Mr. Rungius has been making a large series of paintings of western big game for the New York Zoölogical Society. All of these are from sketches and observations in the field and are valuable records of our disappearing North American wild life

surfaces,—a good point, but one which may easily be carried too far. She is vastly more interested in this study than in the real character of the animal and I therefore mention her work in this connection as diametrically opposite that of Mr. Clark. She has an excellent eye for general proportion and a certain suggestion of movement in her work, yet I feel that she approaches the subject purely as a sculptor and not as a lover of animal life.

Two points of view apparently prevail in any collection of paintings or sculpture connected with this subject: one which deals with the animal as a living creature and gives a portrayal of its exact character as is done in a portrait, the other merely regarding the animal as a piece of color or pattern and treating it accordingly. Both seem logical and I suppose are really correlated, as in most other fields of artistic endeavor.

Mr. Moorepark's interesting compositions in pastel, for example, show a love of color and decorative line, but the birds themselves are often quite lacking in construction and the finer drawing which should accompany every serious attempt in art. The condor in one of these panels is absolutely grotesque in its proportions, with its huge head and puny body. I fear that work of this sort rather takes for granted the general public's lack of knowledge on the subject and for this reason, if for no other, the practice is a bad one. Mr. Moorepark evidently has very little interest in his subjects as living entities, which is to be deplored, as no one who regards them merely as spots of color can grasp the full beauty of the living creatures. They are so fine, so graceful, and withal so vigorous in line and construction that it seems a pity not to do them full justice.

Mr. Benson's studies of wild ducks and geese represent the work of an artist who, if I am not mistaken, began life as a figure painter. They show what one would expect, a knowledge of composition and values essential in the work of a serious painter. I understand that Mr. Benson has had great success with these pictures, yet they are sometimes trivial in handling and not well enough drawn to be convincing. One panel, for example, presents a flight of swans or geese, but the individuals in the group are so carelessly drawn that their real identity

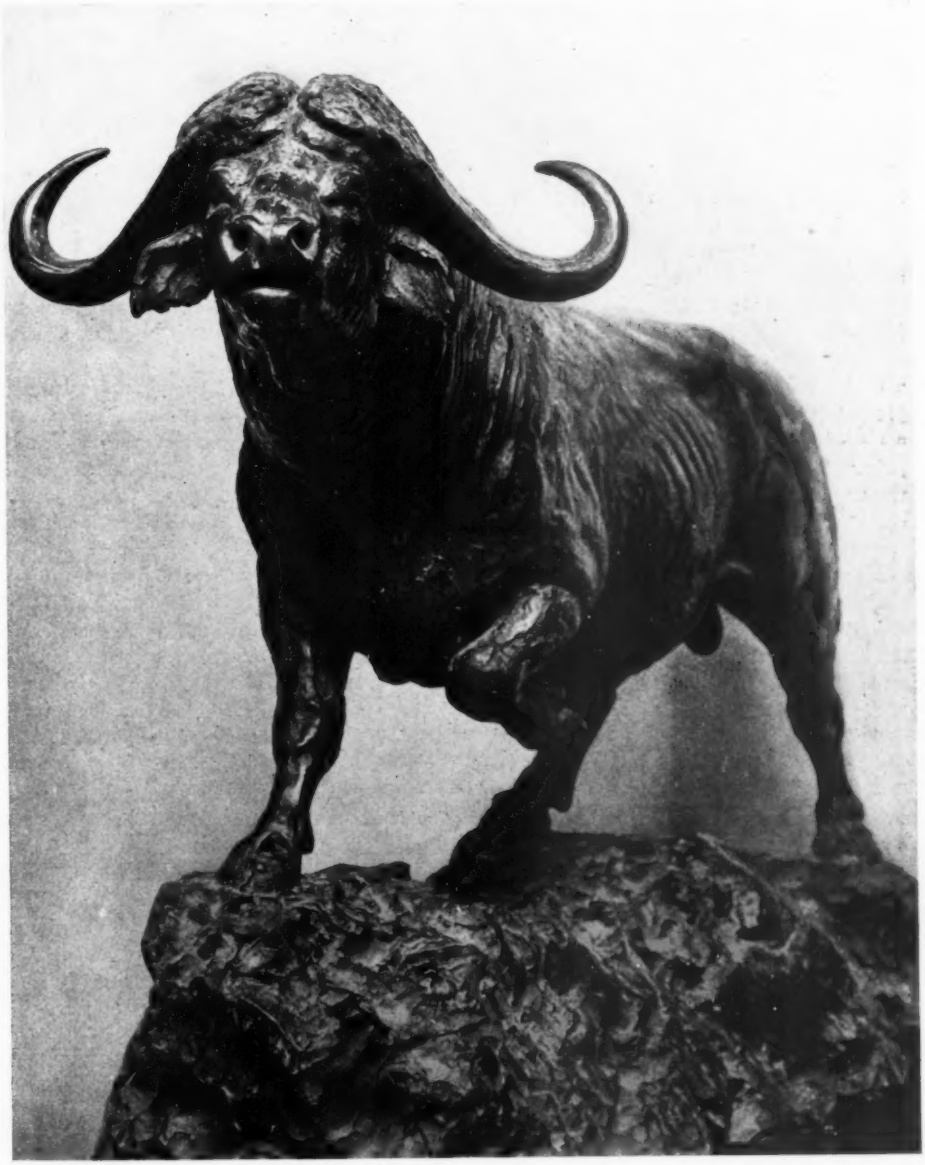
Copyright by Carl Rungius

"The Mountaineers," an oil painting of bighorn sheep, by Carl Rungius, portrays magnificent specimens of an animal in many ways the most picturesque of the Rocky Mountain fauna. Mountain sheep are now so nearly extinct that to attain his sketch Mr. Rungius must have spent many difficult weeks or months among the wilds of the Rockies. *This canvas is one of the series belonging to the New York Zoölogical Society*

is rather a mystery. This seems unnecessary and in no way adds to the artistic effect. In other pictures the character of the birds is most accurately indicated and one gets an impression of life and atmosphere which is very charming. Taken as a whole, the work is interesting and a departure from the more hackneyed paintings of game birds. As a complete contrast with the above, one may mention a drawing of a partridge done by Gerald G. Thayer. This is an elaborately painted work illustrating the value of protective coloration in birds of this species. The picture is unique in its way, as the values of the bird against its background have been most painstakingly indicated, with the result that the creature is almost invisible at first sight, so closely does it merge into its surroundings. It was painted under the personal guidance of the artist's father, Abbott H. Thayer, and exemplifies many of the points so carefully brought out by the celebrated painter in regard to what we now call "camouflage," or the science of concealing an object by means of masses of color artfully distributed over its surface. The picture was loaned by the Metropolitan Museum of Art, and will repay careful study on the part of the observer.

Carl Rungius, rather meagerly represented in this exhibit by his bighorn picture and studies of pronghorn antelope, is a hunter of big game—a man who has lived for months in the mountains of the great West, shooting and painting during a considerable part of each year. All his studies are made in the field, and the animals he depicts are rarely seen in our zoölogical parks where they are represented at best by a few sickly individuals not at all comparable with the magnificent creatures so ably portrayed by the artist. Mr. Rungius has endured hunger and privation in his search for the various species of big game, and he has been working for some years on a series of pictures for the New York Zoölogical Society. These pictures, which include the moose, elk, caribou, antelope, and musk ox, have all been painted in the true environment from sketches made on the spot, and should prove a valuable record of our rapidly vanishing big game animals.

In the work of the artists already referred to, a more or less serious attempt has been made to portray some definite and withal beautiful phase of animal life either decoratively or realistically, but I can detect no such intention on the part of Mr. Nadelman. Rather do I see in the examples of his work a trifling with all that makes for good art



A VALUABLE PERMANENT RECORD OF ONE OF THE MOST DANGEROUS OF AFRICAN BIG GAME

This study in bronze (about two feet high) of the African buffalo, by James L. Clark, is an excellent example not only of fine modeling but also of natural pose and expression. It is a duplicate of the bronze presented by the members of the African Big Game Club of America to the Nairobi Club, in memory of the late Frederick Courtenay Selous, the "Great Hunter, True Sportsman, and Gallant Soldier" who was killed in action in German East Africa, January 3, 1917. One of the most adventuresome of Selous' experiences and the story he liked best to tell, was the occasion when he nearly lost his life before a charging African buffalo

and a generally misdirected energy. The irritating part of it all is that Mr. Nadelman knows better and he presumes upon our good nature when he presents to us as works of art the distorted lumps of bronze which he is pleased to call animal sculpture. When work of this sort is excavated from some prehistoric grave we are lenient in our judgment of it, but there can be no excuse for such monstrosities in our day and time.

As a relief from work of this character, let us turn to that of a sincere student and lover of animals, Mr. Carl E. Akeley. As a hunter, taxidermist, and inventor, Mr. Akeley is well known. He has collected for many years in Africa and his groups of mounted animals in the Field Museum of Natural History, Chicago, and elsewhere deserve all the praise accorded to them. As a sculptor Mr. Akeley is best known by his group "The Wounded Comrade," which shows a wounded bull elephant being assisted to a place of safety by two companions. The work makes a strong human appeal and the sentiment is excellent. "The Elephant Herd Charging" while less dramatic gives one a good idea of a herd of swiftly moving pachyderms. Mr. Akeley is a close student, a keen observer, and above all a serious-minded man who believes in trying to present (as does Mr. Rungius) the actual form and character of animals seldom seen at their best in captivity.

Mr. Charles L. Bull, whose numerous illustrations are well known to readers of our current magazines, is a firm believer in the decorative qualities of animal form and color. His work while based primarily upon that of the Japanese is nevertheless original in conception and treatment. Composition is perhaps Mr. Bull's strongest point, although he shows a fine feeling for color in many of his pictures. His work includes a wide range of subjects but the treatment is substantially the same in all. He affects a flat delineation of surfaces which grows rather monotonous at times, although the lack of roundness in his animal forms is not evident to most people. He shows excellent taste in his arrangements of light and dark surfaces and altogether his work occupies a rather unique place in the field of animal art. If one might criticise work of this sort, I should say that the constant reiteration of a certain scheme of treatment grows rather tiresome no matter how pleasing it may be, and makes one long for some totally different conception of the subject at hand.

In the work of Bruce Horsfall we find a decided contrast to the flat decorative panels so characteristic of Mr. Bull's method, and a return to the strictly realistic point of view. Mr. Horsfall is a trained and competent painter who, while not primarily a lover of animal life, is nevertheless capable of conveying to our minds some very pleasing impressions of animal nature. His "California Condor" is a scholarly piece of work, well painted, well drawn, and withal excellent in character. It depicts the great ungainly bird standing on a rocky ledge, with outstretched wings poised for flight. The sunlight strikes sharply on the grotesquely wrinkled head and neck, and casts a strong shadow upon the glaring yellow cliff in the background. The picture is interesting and convincing, and illustrates what can be done in the portrayal of a wild creature by a skillful and observing man.

It was with great regret that I learned of the untimely death of Mr. Rembrandt Bugatti, shortly after the completion of the "Giraffe," a bronze model loaned to the Brooklyn exhibition by Mrs. H. P. Whitney. Just how much this talented young man knew or cared about animals I cannot say, but the bronze is certainly the work of a clever sculptor and one who, had he lived, might have made a name for himself along these lines. The ungainly body and long awkward legs of the giraffe are nicely indicated, and the modeling itself is thoroughly well done.

Miss Anna Hyatt is represented by several minor pieces which show, nevertheless, her ability to catch and preserve a difficult pose. Her "Jaguar Tearing a Piece of Meat" is well composed and the main action good, but the muscular anatomy of the shoulders is not well understood and the statuette loses something thereby. It is difficult in such a small exhibit to represent adequately the work of any one artist and I very much regret that Miss Hyatt could not have shown at least a small study of her "Joan of Arc," the bronze original of which now occupies a splendid site on Riverside Drive, New York City. This is most certainly Miss Hyatt's supreme effort thus far, and to my mind the best equestrian statue in this country. The sculptor's love of horses has stood her in good stead in this

"PEACOCK AND PANTHER"—STUDY IN ANIMAL FORM AND COLOR

The work of Charles Livingston Bull, well known to the public, always shows originality of conception although often related in treatment to Japanese art. His work covers a very wide range of subjects and is the exponent of his profound belief in the decorative qualities of animal form and color. His canvases are recommended to those who wish to analyze fine composition in animal painting and to develop appreciation of fine feeling for color

Miss Eugénie F. Shonnard at work on the excellent model of Dinah, a young gorilla lately on view at Bronx Park

instance and the figure of the Maid of Orleans is both graceful and statuesque in pose.

Z. H. Pritchard strikes a new note in his paintings of fishes made on the Tahiti reefs. The artist took no end of trouble to obtain these pictures, actually going below the surface of the water to observe his effects. The results are interesting, yet one feels that Mr. Pritchard could have done much more from the art standpoint with his subjects had he been so inclined. The color is interesting but not very convincing as a suggestion of a watery medium.

A. P. Proctor, long and favorably known as an animal sculptor, shows several small works which are mostly studies for his large bronzes. His "Buffalo Bull" is the scale model for the heroic statue recently set up on one of the new bridges in Washington, D. C., while his "Princeton Tiger" is also a carefully wrought statuette, later enlarged for one of the buildings at Princeton, New Jersey. Like all of Mr. Proctor's work, great care has been taken with the superficial finish of the pieces but as a work of art I much prefer the buffalo to the great feline, the former being much better understood in every way. Few men are able to grasp the salient characters of all types of animals with equal facility, and I feel that Mr. Proctor's feline types are rather lacking in this regard. His standing "Puma" for example (made some years ago) is decidedly off anatomically, and certainly does not give one the impression of a great cat standing in an attitude of attention. He is, however, much more happy in his delineation of the horse, and his "Indian and Horse," unfortunately not shown here, is a most excellent piece of work. A number of the animals and birds decorating the buildings in the New York Zoölogical Park are the work of Mr. Proctor, and he has executed many other large and successful commissions throughout the country.

Mr. Julius Rolshoven contributes a large and ambitious panel in pastel and tempera—"Sun Arrow," and several smaller studies. The subject of the panel is an Indian chief mounted on a most extraordinary looking horse, which at first sight seems to have stepped from the canvas of some old Dutch painter. The anachronism leaves a bad impression on the mind of the spectator and discloses a lack of close study on the part of the artist. Surely no Indian brave ever rode such a horse as this, and where Mr. Rolshoven found him, I can't imagine. With all its brilliant color and flashy technique the picture leaves one cold and unimpressed. The smaller studies of Indians,

however, are very charming in color and decidedly interesting.

The small models of birds by Miss Shonnard are very well done and have a certain style and statuesque quality about them most pleasant to see. An excellent bust of Dinah (the young gorilla lately on view in Bronx Park) is unfortunately not shown in this exhibit.

Eli Harvey has one large and several small pieces on exhibition. They are all characterized by this serious sculptor's usual attention to detail and his "Lioness and Cubs" shows very good character indeed. The large roaring lion "Menelik" is excellent as to attitude but the hind quarters seem small and weak for the general physique of the great beast.

Paul Herzel also shows a number of small models of feline types. A lioness and cubs by this young artist strikes me as being particularly good in composition and attitude, but I cannot say as much for the tiger and python model, even though the latter did get a prize in a school exhibition. The action in this group while very violent is decidedly false and unpleasant in conception, and the work is a good example of what not to do in an effort to obtain a dramatic effect. No tiger, I am convinced, would or could assume the attitude shown in this group and the pose of the snake is equally poor. It seems to the writer that all such attempts at super-action are distinctly bad art and should be condemned as such. Barye, the celebrated French sculptor, loved action for its own sake, but he never made the mistake of overdoing the movement of his animals, and therefore the results are always interesting and artistic. Mr. Herzel will, we trust, in the future stick more closely to actualities in his work and direct his undoubted ability into more realistic and beautiful channels.

The very charming little models by Mr. Roth are full of life and action. Mr. Rockwell's fountain and rhino group give evidence of thoughtful care and study, while Miss Crittenden's little pastels are charming in color. Unfortunately, Mr. Chandler's screens had been removed before my visit, but I feel sure that their brilliant color schemes and fanciful arrangements of fishes and birds are very interesting.

The exhibition as a whole is a convincing illustration of the fact that at last the hide-bound prejudices in regard to the depiction of wild animal life as opposed to the domestic forms have been cast aside and henceforth we may hope to see similar exhibitions held in the various art centers throughout the country. Surely there is no good reason why the magnificent wild animal life in the world about us should be relegated to the good graces of men who paint only what are known as "sporting" pictures. We trust that the exhibition just over will direct the eyes of both artist and layman alike to the vast untrodden fields which are open to them in this direction, and that all the magnificent types of wild things may be fully utilized in the reproduction of beautiful and interesting works of art. Let us learn to appreciate as well the great opportunities offered to us by the numerous museums and zoölogical gardens in our great cities, from which the serious student in this branch of art may derive so much pleasure and profit.

A Paradise crane in plaster by Miss Shonnard. Miss Shonnard's small models of birds have a certain style and statuesque quality which are very pleasing. The advantage of art is that it allows emphasis of general form, or line, or color, by keeping the detail subdued in directions which would confuse

MAJESTY OF THE POWER OF BRAIN AND BRAWN EVOLVED IN WILD ANIMALS

The United States shows its youthfulness in the lack of art works in the cities and towns, and is likely in the coming decade to reveal the advancing years of its civilization by a great development in communal art and architecture. Much of this is certain to be carried out in a record of wild animal life. No nation more than the American people has shown fine sentiment toward the preservation of wild birds and animals, but with all this the big game is rapidly becoming extinct. Zoölogical statuary of the highest order will not only set up before us the greatest beauty and power, outside of man, that the earth has evolved, but also will preserve in imperishable stone and metal great races which are vanishing from the ranks of life. The giant Bengal tigers by the sculptor, A. Phimister Proctor, which mark the termination of the Sixteenth Street Bridge, crossing Piney Branch, Washington, are examples of the best animal sculpture to be found in our national capital. Washington was laid out on a predetermined plan and therefore possesses generous opportunities for the use of municipal statuary. Such statues as have been erected, however, are largely war memorials, with few zoölogical subjects, although a number of lions and more or less conventionalized eagles embellish or disfigure certain public monuments. We value highly as subjects for our statues the Old World species—tigers, lions, elephants—for are not these the forms we know from our ancestry, from our literature and traditions? But notwithstanding this cosmopolitan interest, as Americans we should like to see immortalized our native American fauna, in connection with which the pioneer history of the United States has developed

Zoölogical Statuary at the National Capital

By R. W. SHUFELDT

Fellow American Ornithologists' Union, honorary member Royal Australasian Ornithologists' Union, member Zoological Society of London, Academy of Natural Sciences of Philadelphia, and many other scientific societies of Europe and America

IN all modern cities of the civilized nations of the world we find in parks, public places, and buildings, statues which, in the main, are devoted to distinguished personages of one nation or another, to allegorical subjects, and to general designs, usually exemplifying the stage of development attained in that branch of the fine arts at the time of their erection; or else the statues are the materialization of the conceptions of some of the noted sculptors of the period. Often these statues are of great merit, lending a peculiar dignity to the city and to a degree tending to exert, through their presence, an elevating and refining influence upon the minds of the members of the community.

I have turned my attention recently to a special department of this particular activity, with the view of making a study of the merits of such statues in Washington as are purely of a zoölogical type in design, and of those in which animals have been employed in allegorical pieces or groups.[1]

It is surprising how very few animal statues we find in the city of Washington. It is the more to be wondered at because no other city in the world today lends itself better to the exhibition of this branch of art. Washington's streets and avenues are, in the main, generously laid out, with great width between the broad sidewalks; they are abundantly lit at night by electricity and are ever tidy in appearance; their numerous intersections at common points are often the chosen sites for "circles" or parks of various dimensions. These are admirable locations for statues, pieces, or groups, and are usually available for such purposes. Many of them have already been utilized in this manner, and we find, in not a few instances, bronze statues of heroes of our Civil War, commanders of the Federal troops in that conflict. With these the present article has nothing to do; nor is it my purpose to take into consideration those groups in which horses form a part. Although they are, in a way, zoölogical, they are not of the ferine class which I have in mind for treatment.

Taking animals in natural sequence, it may be pointed out that fish and reptiles but rarely enter into sculpture of the class under consideration; still, some nondescript animals of the latter group are to be seen in the great fountain in the Botanical Gardens, and a more elaborate representation of a similar form is found in the famous Hinton Perry fountain of the Congressional Library, where we see on the primal base at the foot of Neptune, certain frogs, hawksbill turtles, and an eel-like creature which seems to have been modeled after the famous Japanese shark, *Chlamydoselachus anguineus* —the oldest existing type of vertebrate, named and described by the late Samuel Garman. The fore-flippers of the turtles (*Caretta imbricata*) are too long and too narrow for adult examples, and it would appear that the distinguished sculptor of this group selected rather young specimens for his models. As we know, the limbs—especially the forepair—are proportionately much narrower and longer in the subadult animal than in the matured specimen.

Among birds, the eagle is the only species that has been selected for representation, so far as I have observed; and that this has been used is doubtless due to the fact that the eagle happens to be the emblem of the United States of America. In no instance known to me is the eagle represented naturally in any piece of sculpture, or in any metal reproduction, in the city of Washington,—that is, so far as groups in public places are concerned. Scores of these birds are to be found, either as single pieces or in groups; but they are all more or less idealized, and performing some feat that makes them appear ridiculous, from whatever viewpoint we may select. The arrangement and number of the feathers in the wings and tail

[1] In pursuing this study I have been assisted in the matter of obtaining data by Col. William W. Harts, Corps of Engineers, United States Army, in charge of public buildings and grounds at the national capital, and by Daniel J. Donovan, secretary to the Commissioners of the District of Columbia, to both of whom it affords me pleasure to extend my thanks.

Illustrations from photographs by the Author

One of the four concrete lions, modeled by a New York sculptor in 1909, for the Connecticut Avenue Bridge, Washington. This figure is on the southwest end of the bridge and measures nine feet in height and twelve feet long. Here was an opportunity to model the great "King of Beasts" so that the majesty of his creation would appeal to all observers through generations to come. Instead we have what appear to be "sick lions unwillingly pulled from some passing menagerie, to pose just as death was overtaking them"

One of a pair of lions on the Columbus Memorial, Washington, modeled by a Chicago sculptor. This also is an instance where the sculptured marble brings little pride to American art of the twentieth century

are invariably incorrect; other parts are not in due proportion, much less natural. The eagles at the base of the McClellan statue, opposite "The Highlands," are supporting a heavy wreath in the most unnatural way imaginable, and the sight is sufficient to send chills down the spine of any well-informed ornithologist. There could not have been a more fitting opportunity to have placed at every angle of the base of this handsome production a fine, adult eagle, in bronze or other suitable metal, of natural size, normal proportions, and perfect in all other respects. There are plenty of live birds in the big, out-door eagle cage at the National Zoölogical Park, not fifteen minutes' walk from this McClellan statue, that the sculptor might have selected as models for this work. Indeed, in my opinion, this is one of the purposes for which we keep wild animals confined in zoölogical gardens; at least, it is just as important a purpose as any other to serve as an excuse for our making life prisoners of these creatures.

Speaking of the National Zoölogical Park, here is certainly an opportunity of the first order to introduce some work of the class I am considering. Especially is this true of mammalian sculpture, which at present is not represented there. All of the entrances to this great reservation for the public exhibition of captive animals from all parts of the world, are singularly unattractive and primitive in character, and to no little degree a disgrace to such a country as ours; this applies particularly to the main entrance on the Connecticut Avenue side. Apart from a few simple signboards placed there, nothing indicates to the visitor that he is about to enter the confines of the National Zoölogical Park of the United States of America. For example, we find nothing to correspond to the fine lion group at the Girard Avenue entrance to the Zoölogical Gardens of Philadelphia, or to simi-

Lion statue on one of the marble pedestals of the unfinished Grant Memorial in the Botanical Gardens, Washington.—Our native big game fauna is large—antelope, elk, moose, buffalo, musk ox, mountain goat and sheep, several species of deer, and all the bears. Any of these would appear with strength and beauty and dignity in our municipal or national statuary; and so fast are they becoming exterminated it will be as if only tomorrow—in the story of the earth's history—that all have disappeared

lar groups in other parts of the world. Surely it is time that a suitable sum be appropriated for this purpose. Let us trust that, when it does come about, when the proposed enterprise can be properly financed, animal statues worthy of the name will be selected by the authorities having this important matter in charge.

Personally, I am distinctly opposed to the choosing of non-indigenous animals for projects of this kind. In Washington, foreign animals have been employed altogether too often as subjects for statues of this class. There are lions here, lions there, lions everywhere, and several of them very impossible lions at that. We have an unusual number of large mammals in this country, all of which are upon the highroad to extinction; among these I may mention the antelope, the elk, the buffalo, the musk ox, the mountain goat and sheep, several species of deer, and all of the bears. Comparatively speaking, the time is not far off when the greater number of these animals will be exterminated; we shall know them only through preserved skins, mounted museum specimens, and pictures of various kinds—all of which are more or less perishable in their nature.

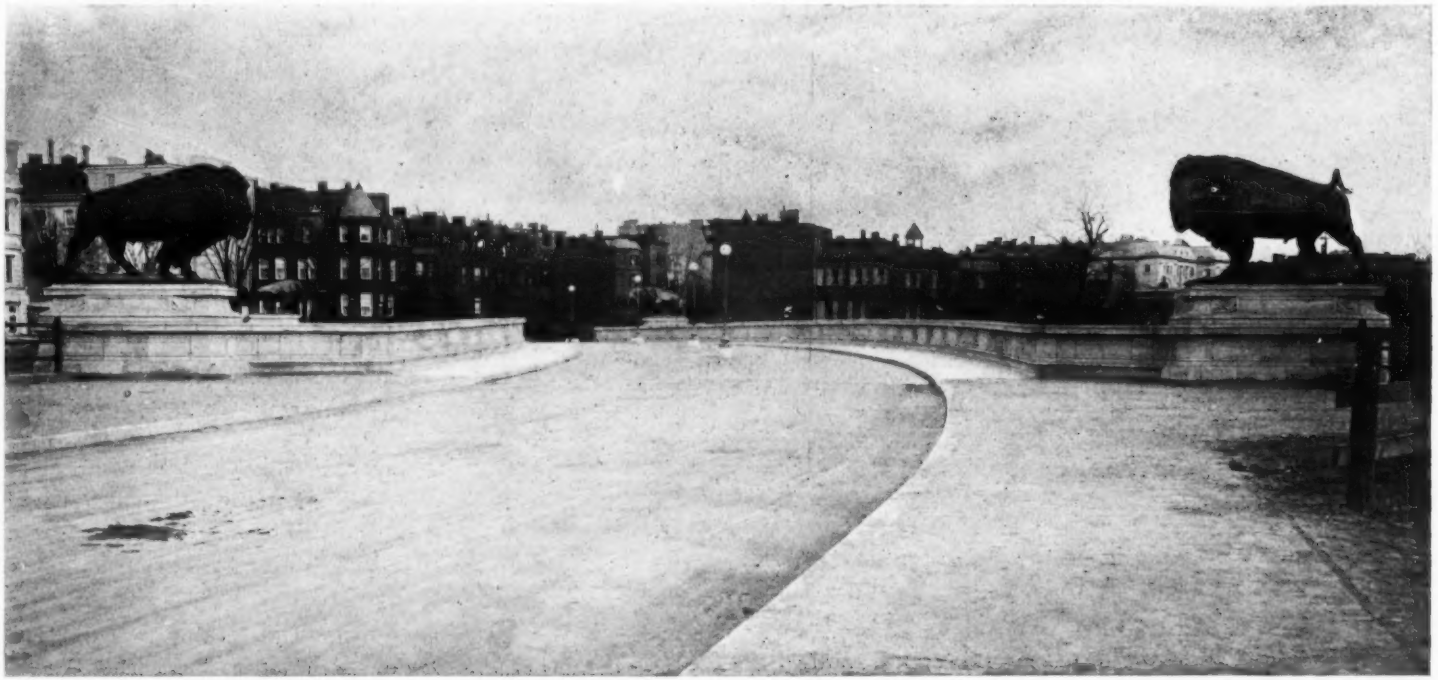
What would form at this time a desirable addition to the National Zoölogical Park would be two life-size statues of famous American mammals in bronze, placed upon suitable pedestals at the main entrance on Connecticut Avenue. Perhaps none better could be selected for this particular purpose than an adult, antlered, bull elk, in a characteristic pose, upon the one hand, and, on the other, an old, male moose, modeled after as fine a specimen as the northern wilds can furnish. The work should be placed in the hands of a sculptor familiar with the superficial or topographical anatomy of these animals, as well as with their characteristic poses in nature. In time, similar statues could be placed at the remaining entrances to this Park, in keeping with their importance and in harmony with their surroundings. Finally, at suitable points within the Park, another piece or two—perhaps three—could be placed to good advantage. One of these might be an extinct animal form, for example, the ponderous *Stegosaurus stenops*, the ancient herbivore so successfully modeled recently by Mr. Charles W. Gilmore, of the United States National Museum.

Personally, I am much averse to sculptural license in the modeling of the animal pieces that are to occupy various salient points throughout the city. There is no excuse for such unscientific and often ghastly work. It is a miserable, misdirected expenditure of funds, and publicly perpetuates a bunch of errors in comparative anatomy and practical zoölogy that can have only an undesirable effect upon the mind of the populace, old and young, as it passes down the ages to come. Take for example the four concrete lions that occupy the terminating pedestals of the Connecticut Avenue bridge, one upon either hand at the entrances.

Here was an unusual opportunity to place a couple of pieces that would have been not only a credit to the nation but also a source of inspiration and education to the people for generations to come. But what have we? The sculptures present the appearance of sick lions, unwillingly pulled from some passing menagerie, to pose just as death was overtaking them. No lion living ever possessed such a form as has been given to any one of these by the sculptor. Their musculature is absolutely incorrect in every particular, and idealism has been carried to the point of the ridiculous; they appear like starved, dead lions, with impossible muscles, manes, and morphology, bolstered up in cadaveric poses.

Even more impossible leonine pieces are those on the Columbus Memorial, in front of the Union Station. These lions are hideous in their facial expressions, terrible in their unnatural proportions, and passing strange in their superficial anatomy. Muscles are shown that have no existence in nature and are absurd from any point from which we may study or view them. They are pitiable examples of the cheap, American sculptural work of the twentieth century, and they will, in the years to come, furnish food for laughter and ridicule for students of correct lines in animal contours and normal poses of the big carnivores of the present time. No lion ever looked the least bit like the two that confront one on this celebrated Columbus Memorial in Washington.

Better lions are those upon the marble pedestals which form a part of the Grant Memorial in the Botanical Gardens, opposite the Capitol. This elaborate and long unfinished piece of work was intended to commemorate the deeds of a great American military hero; but it stands now as



THE SPIRIT OF GRANDEUR OF THE WESTERN PLAINS BROUGHT TO THE SPACIOUS AVENUES OF THE NATIONAL CAPITAL

Four American bison of heroic size were modeled and cast in bronze by A. Phimister Proctor in 1915 for the terminals of the Q Street Bridge, Washington. In these Mr. Proctor does not let what is natural in form and pose be overruled by the principles of conventionalism in art. It is easy to understand that in the case of animal forms used as a motive in architecture even the lines of nature may be drawn away from their realistic course for the sake of harmony with the whole, but such deviation from the naturalistic could never be valid in an isolated statue

Bengal tiger on the Sixteenth Street Bridge, Washington (see front view of the same figure, page 470).—This great cat, ten feet long in the bronze, by Proctor, 1911, has been given a pose characteristically feline, and the anatomical detail, where indicated, is perfect, giving a result altogether pleasing both to the zoölogist and the artist

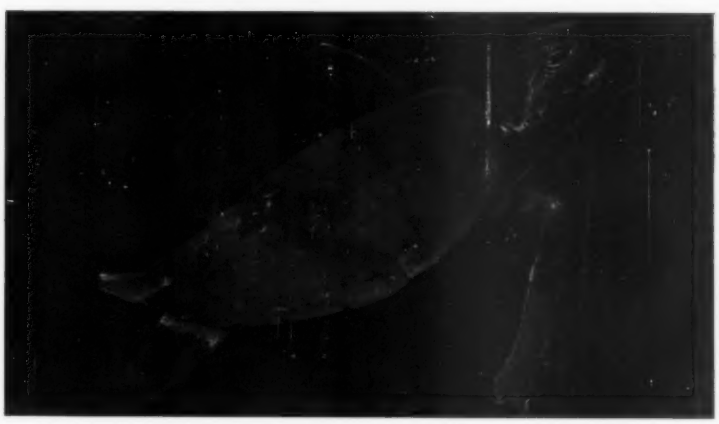
The Sixteenth Street Bridge is an object of admiration in the eyes of all visitors to Washington, and the bronze tigers of heroic size lend an appreciable dignity and elegance to the highway. It is suggested that at the entrances of the National Zoölogical Park the addition of life-size statues of American big game, especially of elk and moose, would fill a great present need

though evidence of an ease in forgetting our country's great among the warriors she has produced in her history and civilization.

Apart from their glorifying representatives of the mammalian fauna of certain parts of India, the four bronze Bengal tigers on the Sixteenth Street Bridge, crossing Piney Branch, are superb pieces of work. The pose, which is the same in each animal, is full of dignity, natural, and with a certain subtle meaning that is not only characteristically feline, but especially appropriate for pieces of this character, occupying, as they do, a prominent position in one of the best known avenues of a modern city. Washington is to be congratulated upon this achievement; and Proctor's great, tigerine cats will be objects of admiration for all who view them in the ages to come.

Proctor was also given the opportunity to model and erect four bronze American bisons at the terminals of the Q Street Bridge (crossing Rock Creek in line of Q Street, between Twenty-third and Twenty-fifth streets)—a work which was finished July 22, 1915, or four years after his bronze tigers were completed.

It will be at once observed that in his idealization of animal poses, Mr. Proctor does not allow the just principles of conventionalism in sculpture and modeling to overrule what we recognize to be natural. His conception of how the American buffalo should be represented for the purpose for which he employed it, most emphatically stands for this. These four splendid bisons are sculptured or cast so close to nature that their grandeur and naturalness impress all beholders favorably. Their very presence at the entrances to the above-named bridge at once stamps the latter as one of a series of famous spans in the history of American enterprises of that character. And it is to be fervently hoped when Washington comes to repeat such work in other parts of the city, that each achievement will bear the stamp of a similar knowledge of requirements; that it will prove to be an exposition of all that constitutes a correct conception of zoölogical and anatomical facts as we know them, and that this knowledge will be employed, in any particular instance, to perpetuate the normal and the real in such of our big mammals as we may select for the purpose, especially as these creatures are being as rapidly exterminated upon this continent as they are in the wilds of other parts of the world.



Few instances of fish or reptiles in statuary can be found. There are hawksbill turtles and frogs on the base, at the feet of Neptune, in the famous Hinton Perry fountain of the Congressional Library, Washington. As shown in the photograph a very young specimen of the hawksbill must have been used as model, indicated by the great length and slenderness of the foreflippers

ANIMAL POPULATION FOUND ON MUD BOTTOM OF ONEIDA LAKE

A biological survey of Oneida Lake, New York, illustrates the relation of physical environment to plant and animal life. Six general types of lake bottom could be definitely distinguished: bowlder, gravel, sand, sandy clay, clay, and mud. These different soils support varied types of vegetation, which in turn serve as food for different animal groups, which in their turn serve as food for various species of fish. Although the invertebrates and plants of the lake are not directly of economic interest to man, they are, in their capacity of food supply for the edible fish, of great and hitherto largely unrecognized importance.

In the above photograph are assembled the invertebrate animals collected on 768 square inches of mud bottom under eleven feet of water. The animal life here is principally molluscan, snails and finger-nail clams. Caddis fly cases, mostly empty, a few midge larvæ (*Chironomus*) and a dragon fly larva (*Tetragoneuria*) are also present. [The last-named, unfortunately for the attractiveness of its portrait, has lost four of its legs]

Studies in Aquiculture or Fresh-water Farming

By FRANK COLLINS BAKER

Curator, Museum of Natural History, University of Illinois

THE great war that has but recently come to a close has shown in a most forceful manner the intimate relationship between the food supply and the well-being of the human race. Food shortage has caused our people more or less willingly to economize food supplies and to increase food production, and to submit almost without a murmur to restrictions that in peace times would not have been tolerated. Perhaps nothing other than this world tragedy could have turned the attention of the nation so intensively to the study of increased crops. Yields of wheat and of corn have risen to unthought-of proportions and the vast number of home gardens attest the magnificent spirit of the American people in meeting the problems of decreased food supply.

And while the land is being made to give up an ever increasing share of its products, the waters are being studied and experiments carried on to demonstrate the possibilities of water culture. But the water has received no such careful study as the land; yet there are immense, almost unknown possibilities in the way of food crop productions in our inland lakes and rivers. These possibilities are being realized in some places and extensive and far-reaching studies have been made, principally in the states of Illinois, New York, and Wisconsin. From these studies, and from others carried on by the Federal Bureau of Fisheries, it has been shown that crops of fish and aquatic food animals can be raised in ponds and streams, artificial and natural, that rival or surpass in value the land crops produced from the same area. Much has been done for agriculture through the various agencies organized for the solution of its problems. Aquiculture, or the study of the conditions governing the production of animals and plants living in fresh water, has received no such extended investigation and we are still ignorant of many important facts which are necessary before aquiculture is on the same sound basis as agriculture.

Professor S. A. Forbes, whose early studies of the food of fishes in Illinois waters have been epoch-making, likens a pond or lake to a microcosm or miniature world. In it all of the processes of life go on almost independently of the land around it. But within this microcosm all are interdependent, the large fish feeding upon the smaller organisms, and these in turn upon those still smaller, and agencies that affect any one group of animals or plants influence in a more or less marked degree the whole life of the pond. Furthermore, in studying any one organism in this microcosm it is necessary to include all organisms, as well as all physical agencies, that are related to it or that come in contact with it. For example, if we wish to understand the life history of our black bass, one of our most valued food and game fishes, we must not only learn what we can concerning this fish, but also what it feeds upon, what the food supply feeds upon, and finally the general character of the environment, whether favorable or unfavorable. In other words, a complete natural history survey of the pond life is necessary to understand fully the history and value of this beautiful fish, or of any fish.

Realizing the poverty of our knowledge on the subject of fish life as it relates to the food supply and to general ecological conditions, the New York State College of Forestry at Syracuse University sought to remedy this defect, in a measure, by carrying on studies in Oneida Lake, New York's largest inland lake. Accordingly, Dr. C. C. Adams, of the Department of Forest Zoölogy, College of Forestry, established laboratories on the lake, and the writer was privileged to conduct studies bearing on these problems during 1915, 1916, and 1917. These studies included examinations of the stomach contents of fish to ascertain the kind and quantity of food eaten; an intensive study of the animal and plant life of the lake to ascertain the relation of the biota to the fish fauna; and quantitative studies to find out, if possible, the size of the fish fauna that the lake was able to

Sand bottom in Oneida Lake is usually found in lagoons and other spots protected from the direct action of the waves. In such places the bulrushes flourish and here are found the best conditions for the growth of the small clams, snails, and insects which form an important element of the food of fish. This photograph of the sand bottom area of the lagoon east of the steamboat landing, Lower South Bay, was taken from a mud bottom habitat in the foreground where the vegetation is more dense but less favorable for mollusks, and illustrates the close relation between the lake fauna and flora and the type of lake bottom. The lagoon is one of the best habitats for the filamentous algæ known as *Cladophora*

The invertebrate population of a sixteen-inch square of sand bottom under four feet of water. The bivalve mollusk (*Sphærium*) at the left, the pond snails (*Lymnæa*) below the center, and small snails (*Amnicola*) in the lower right-hand corner are in notable predominance. Only five animals other than mollusks were found here, although over the sand bottom as a whole the latter make up only about 50 per cent of the invertebrate life. The mollusks of this lake serve as food especially for the pumpkin seed and the common sucker and indirectly for the bass and pike which eat mollusk-eating fish

support with the amount of the biota present. The investigations, in a way, paralleled those carried on in the study of agricultural problems, the environments of the objects studied being quite different.

Fully realizing the significance of the fact that the lake is a microcosm, the problem resolved itself into a study of the relation of the fish fauna to the general physical characteristics of the environment, to the biota as a whole, and to the other members of the fish fauna present in the lake. The data for solving such a problem can be obtained only by making an intensive and exhaustive survey of the body of water. To accomplish this result it was decided to select a limited area of known extent and to study this from several angles. Oneida Lake is 21 miles long and more than five miles wide and has a maximum depth of 55 feet which occurs near the east end of the lake. There are several large bays or indentations which provide admirable localities for habitat studies. One of these, Lower South Bay, situated near the southwest end of the lake, was selected for carrying on the intensive studies planned. This bay is one and five eighths miles long and about a mile wide and contains 881 acres of surface water. It is a comparatively shallow body of water, ranging from a foot or two in depth at the west end to nineteen feet at the east end where it enters the larger lake. It is protected on the west and south sides by the land which rises more or less abruptly from the shore; on the north a long point and several shallows protect it from the rough water. At the east end, however, it is open to the storms from this direction which have a more or less marked influence upon the bay.

In this investigation one of our aims, and perhaps the chief aim, was to ascertain as definitely as possible the actual amount, numerically, of animal life that lived on the bottom or on the vegetation at this time of the year (July). To accomplish this result dredges were constructed to take up a portion of the bottom measuring approximately four inches square or sixteen square inches. On a rocky shore a number of bowlders were carefully removed from the water and all of the life, both animal and vegetal, was removed to vials to be sorted and counted later. Vegetation was carefully taken from the water and the attached animals removed. To minimize the liability of error a large number of samples were collected (upward of 800). When sorted and identified this material gave a clear idea of the relation of animals to the different kinds of bottom, to the vegetation, and to each other. A feature of the investigation worthy of mention is the fact that more than twenty-five specialists, many of them in the front rank of America's biologists, coöperated in the identification of the different groups of animals and plants. In this way only can results of a dependable character be obtained.

To support a large plant and animal population a body of water must provide varied and suitable conditions, and these are found in Oneida Lake in abundance. Detailed studies indicate that there are three primary types or kinds of these habitats which are more or less distinct. The first includes the headlands or points and some portions of the shore which are shallow and have been swept clean of fine sand and clay, leaving the stones and small bowlders as a rocky pavement, the stones ranging in size from large gravel to huge bowlders several feet in diameter. This type of habitat affords lodgment for many mussels which live in the sand or gravel between the stones, for a multitude of snails which live on the rocks, and for crawfish, insect larvæ, and leeches which live on, under, and between the rocks. The vegetation of such habitats consists of water willow and bulrush.

The second kind of habitat is found in sheltered bays and in other partly protected spots where the force of the waves is somewhat arrested. The bottom is composed of fine sand; the vegetation is abundant, consisting of pickerel weed, bulrush, swamp loosestrife, bur reed, the water lilies, and a few pondweeds (*Potamogeton*). Many mussels live here, but the most important life is made up of small clams, snails, insects, and other small animals which form such a large proportion of the food of fish.

The third kind of habitat is found in the well protected bays, where there is a mass of vegetation consisting of submerged plants such as pondweeds, hornworts, milfoils, water lilies, and the emergent plants such as pickerel weeds, cat-tails, and bur reeds. The bottom is usually of fine clay or mud. Many fragile snails as well as insect larvæ inhabit this kind of habitat which provides excellent food for fish and other aquatic animals.

The striking feature of the plant life in many habitats, which was constantly forced upon our attention, was the presence of large quantities of the water plants known as filamentous algæ, which covered the bottom as well as the higher plants like a thick blanket, and greatly modified the natural character of the bottom. It seems probable that the great wealth of animal life in parts of this lake is largely due to the presence of this lowly plant, which provides a rich food supply for the invertebrate animals.

In the bays and the shallow areas bordering the shores of this beautiful lake, the floor is carpeted with a great variety of plants, many of which, like the feathery water milfoil (*Myriophyllum*), form miniature aquatic forests. The rocks, the plants, and the whole bottom in many places are covered with masses of the delicate green water plants, the filamentous algæ.

Among this wealth of plant growth many kinds of animals live in great abundance. The algæ are inhabited by the young or larvæ of flies, and small jointed worms related to the earthworms (Oligochæta), whose bodies are as green as the color of the algæ which they have eaten. Myriads of little crustaceans, called scuds or water fleas (amphipods and Cladocera), dart about and thousands of fresh-water sow bugs (isopods) crawl over the filmy masses of algæ. The little spider-like mites (hydrachnids) actively search the algæ and weeds to prey upon the smaller animals. The young or nymphs of dragon flies (Odonata) lie in ambush among the algæ or bury themselves in the muddy bottom; the young of May flies, with their feathery gills attached to the outside of the body, and the caddis fly larvæ, with their curious houses or cases made of grains of sand, snail shells, bits of sticks, and plants, crawl over the bottom, dragging after them the houses that protect their soft bodies. Water bugs, water boatmen, beetles, both adult and young, and many kinds of snails complete the variety of this wealth of animal life on the bottom.

The rocky shores afford good foraging ground for many snails, with which are associated the young of May flies (*Hexagenia*), the flat, disklike larvæ of a beetle (*Psephenus*), the spiral caddis fly (*Helicopsyche*), that resembles a snail, and other small animals, such as worms and leeches. The stones on many points are covered with sponges which look like patches of green velvet through the water. The higher plants afford resting places as well as foraging grounds for many snails, aphids or plant lice, some beetles, and numerous hydras.

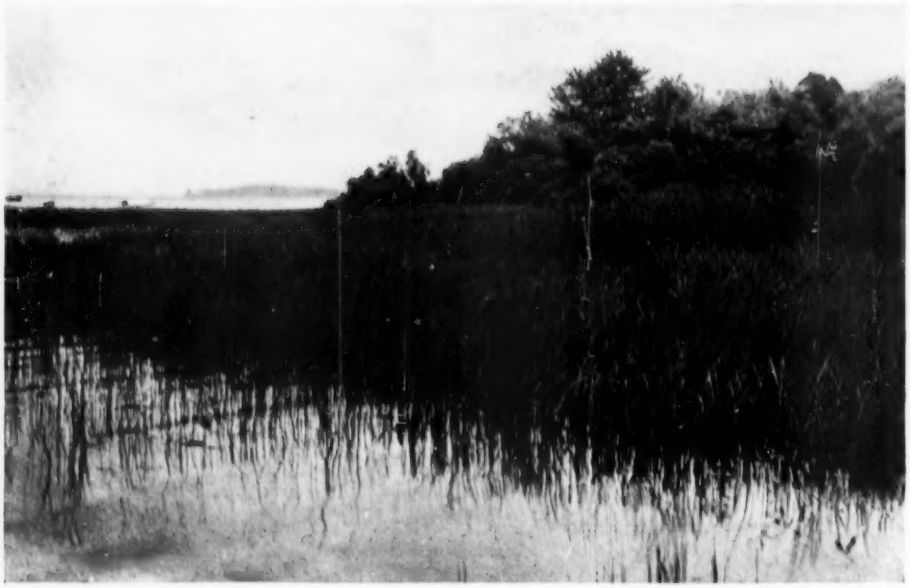
The study of this rich storehouse of animal life by the unit area method brought out many facts of interest and importance concerning the distribution of life in this body of water. There are several diverse habitats and the animal and plant life show a corresponding variation. Dividing the bay into three areas, each separated by a contour line at 6, 12, and 18 feet, we find that the greatest development of invertebrate life occurs within the six foot contour. Of the 1164 acres of bottom examined in Lower South Bay and vicinity, 205 acres occur between the shore and the six-foot contour and 959 acres lie beyond this line in deeper water. Careful computations indicate that 88 per cent of the total individual animal life lives in water six feet or less in depth, and that but 12 per cent lives in the deeper water of the area surveyed. When reduced to actual figures, which in a measure are difficult to comprehend, the result shows that upward of 6786 million individuals live in 205 acres in water six feet or less in depth, while but one million individuals live in 959 acres in water deeper than six feet.

When we consider this animal life in relation to acres the results are clearer and can better be compared with acreage productions of land crops. To the acre, the invertebrate animals within the six-foot contour number 33 million individuals, while beyond this line in deeper water the life per acre is but one million individuals, the shallower water being 33 times as productive of life as the deeper acres of the bay. These figures, of course, do not include the plankton, or floating population, only those animals that cling to some support, the bottom or the vegetation. The addition of this population would greatly increase the numerical results, but it was only with the bottom fauna that these studies were concerned.

The population of the 6–12 and 12–18-foot contours does not show such a marked drop in individuals, the water deeper than 12 feet containing 59 per cent of the population of the deeper areas. When we remember that fish life, as well as other aquatic vertebrate life, is more abundant in water six feet or less in depth, and that here the greater number

On the clay and sandy-bottomed portion of Lower South Bay of Oneida Lake the shore is bordered with the typical growth of cat-tails, surrounded on the lake side by American bulrushes. The lake here is only about one foot and a half to four feet deep and well protected from waves, which have a marked effect on vegetation. In all parts of the bay large quantities of vegetable débris are found floating in the water and covering the bottom. Even the "dust-fine detritus" is probably a valuable source of food for many of the mollusks and crustaceans, as well as for the bottom mud-eating fish. The bay, with its abundance of vegetation, affords excellent breeding grounds for the fish of the lake, particularly those species which build nests, such as black bass and rock bass

Animals collected on sixteen square inches of clay bottom from the southwest shore of the bay. Caddis fly larvæ, *Agraylea* and *Phryganeidæ* (upper right-hand corner), the snails, *Amnicola*, the fresh-water sow bugs, *Asellus* (lower right-hand corner) and scuds (*Hyalella*) are the more conspicuous forms. These are food for crawfish and frogs which are in turn eaten by pickerel and yellow perch. Bivalve mollusks are notably absent from clay bottoms and altogether in this area there are only half as many mollusks as other animals. When the sand becomes intermixed with the clay, however, the mollusks increase in frequency



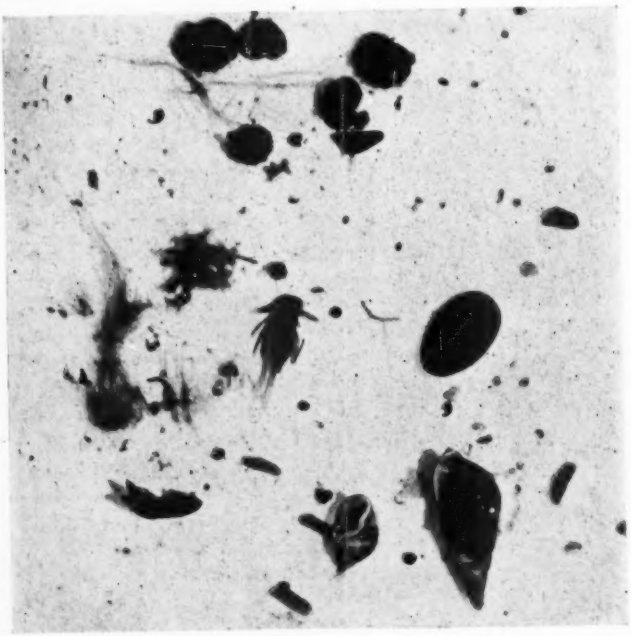
The south side of Lower South Bay illustrates the vegetation on sandy clay bottoms, particularly the cat tails along the shore. These are not found on sand. Bordering the cat tails on the lake side grow the ever present bulrushes. From the point of view of animal population the most important vegetation in this area is composed of submerged plants and especially the algæ which coat the bottom and other plants, and which float in filamentous masses. The algæ supply the most valuable vegetable food of the invertebrates of the lake

Invertebrates supplied by one hundred square feet of surface on a log five feet under water. The principal forms are the snails (*Bythinia* and *Amnicola*) and the scuds (*Hyalella knickerbockeri*). The latter crustaceans are eaten by fishes and frogs, and are also useful scavengers. It was notable that the sunken log which served as a home for these animals was covered with a thick coating of filamentous algæ and this undoubtedly supplied their chief source of food

Lower South Bay of Oneida Lake looking west from Short Point.—This shows a transition from the shallow bowldery point in the foreground, with its scanty vegetation of water willow, to the protected bay in the background with its sandy or clay bottom and its abundant vegetation of cattail, willow, lake bulrush, water lilies, pickerel weed, and a number of pond weeds. In general, bowlders and gravel cover the floor of exposed points, while shallow bays have sandy bottoms and those of the deeper bays and the main floor of the pond are composed of clay and mud. By far the greater part of plant and animal life of the lake is found where the water is less than six feet deep; below a depth of twelve feet there is little or no vegetation

Invertebrates yielded by approximately 768 square inches of mud bottom under ten feet of water, illustrating the marked falling off in numbers with increased depth, especially of mollusks. Fingernail clams (*Pisidium*), snail shells (*Amnicola*), the larvæ of midges (*Chironomus*), and the nymphs of May flies (*Hexagenia*) are the principal animals; the caddis fly cases (on the left) are practically all empty. The larvæ are of great importance in the food supply of most of the larger species in the lake including other nymphs and larvæ; the May flies are eaten especially by pickerel. The mussels which were taken in this area are not shown in the photograph

A rocky wind-swept shore devoid of vegetation.—From Long Point, north side of Lower South Bay, an exposed gravel bowlder bottom extends into the lake on all sides. Mollusks easily obtain a foothold on the bowlders and among the gravel. Crawfish, insect larvæ, and leeches also live on, under, and between the rocks, and many small fishes feed hereabouts



This group of invertebrates, taken from a small bowlder in water 20 inches deep, consists mostly of insect larvæ (beetle, caddis fly and May fly) and of snails (*Goniobasis*). Bowlder bottoms have the smallest percentage of the plant life of shallow water areas, although they afford good feeding grounds for minnows and young fish, even in water only a few inches deep. Most fish vary their food with age, at first taking only the smallest insects and larvæ

of young fish live and adult fish breed, the significance of this rich store of animal and plant life in shallow water is at once apparent and the importance of studies in such areas bordering the shores is at once recognized. It is in such situations that fish culture can be carried on most successfully.

The kind of bottom was also found to play a large part in the abundance or scarcity of animal life. In Oneida Lake six kinds of bottom are found, depending upon the physical condition of the shore: bowlder, gravel, sand, sandy clay, clay, and mud. Of these different kinds of bottom, sand supported the greatest number of individuals. If the sand bottom be valued at 100 per cent, the relative values of the other kinds of bottom, as related to number of individual animals, stand as follows: sandy clay, 87 per cent; clay, 66 per cent; gravel, 57 per cent; mud, 42 per cent; bowlder, 36 per cent. It will be noted, therefore, that not only depth acts as a controlling factor in the density of the fauna, but also the character of the bottom material.

One of the chief factors in providing a favorable environment for the development of animal life is the presence of an abundant and varied flora. In Oneida Lake the vegetation fully measures up to the maximum requirements in this respect as has already been indicated. The value of this abundance of vegetation is perhaps not fully realized by many fish

culturists. It may be said without fear of successful contradiction that when the flora is insufficient or wanting the animal life will be correspondingly rare or absent. There is also another source of food supply which has received little attention by American students of fish culture. This is the fine covering of the bottom which Dr. C. G. Joh. Petersen, the Danish biologist and fish culturist, has called dust-fine detritus. This material is composed of the finely comminuted fragments of vegetation, together with diatoms, desmids, and other biotic material, and is largely used by many of the invertebrate animals and by some fish as food. It is believed by Petersen and other Danish workers on fish food problems that this is of greater value than the plankton organisms which are so abundant in most of our fresh-water lakes. It is known that marine animals use it to a large extent but its proportionate use by the inhabitants of fresh-water ponds and streams is not definitely known. That it is of some, if not great value, is highly probable.

When we consider the sources of food of the invertebrate population of this bay, as well as other bodies of fresh water, we find that the herbivorous animals, those that live on plants and detritus, greatly predominate over the animals that have carnivorous habits and prey upon the other animals present. Dividing the population of the area of Lower South Bay into herbivorous and carnivorous animals we find the astounding result of 7743 million individuals that feed on plants and detritus against 23 million individuals that are carnivorous. In per cents this means that the carnivorous animals make up but $\frac{3}{10}$ of 1 per cent of the entire population. This fact is of great importance, for the herbivorous animals are producers of fish food and the carnivorous animals are consumers of fish food. While the carnivorous animals are of some food value to fish, it is the great mass of herbivorous animals that is transforming plants and débris into animal flesh, that forms the principal food supply of our food and game fishes.

One of the most interesting features of the Oneida Lake investigation was the variety of animal life found on the bottom of Lower South Bay. Seven of the ten phyla of invertebrate animals (the Protozoa are not considered for obvious reasons) are represented by twenty-five classes or higher groups, forming a microcosm of large size and great variety.

The mollusks, snails and clams, and the insects are about equal in number of species, the mollusks forming 35 per cent of the entire number of species represented. When the number of individuals of the two groups, mollusks and the other associated animals, are compared, it is found that the former are 30 per cent greater in number. This preponderance of mollusks over associated animals has also been noted by students conducting marine investigations. Of the 7766 million individuals of invertebrate animals calculated to be present on the bottom of Lower South Bay and vicinity, 4704 million are mollusks and 3062 million are associated animals. The mollusks or shellfish form a large part of the food of such valuable fish as the sturgeon, sheepshead, suckers, red horse, whitefish, pumpkin seed, and bullheads. Of the 225 different species of fish inhabiting the waters of Illinois and New York, 46 or about one fifth are eaters of shellfish to a greater or less degree. Of all the classes of food, insects are by far the most valuable, about 40 per cent of the food of all fishes being of this group of animals.

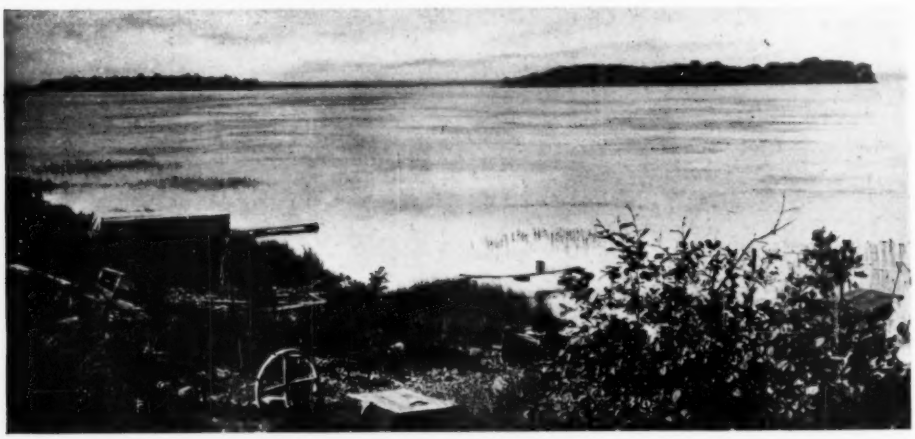
One of the results hoped for in the Oneida Lake investigations was a knowledge of the size of the fish fauna that the natural food of the lake could support. To find this it was necessary to know the amount of food eaten in a period of time, as in twenty-four hours. Studies on marine fish (notably the plaice) indicated that the digestive canal was emptied once in twenty-four hours. These marine fish, however, are not strictly comparable with the fresh-water fish in this respect. In 1917, a study of fish caught in trap nets and allowed to remain in these nets for a period of 24, 48, and 72 hours, indicated that the digestive tract might be emptied in about 24 hours. Of the fish caught, 50 per cent had full stomachs in the 24-hour interval, 13 per cent in the 48-hour interval, and all were empty in the 72-hour interval.

It is known that the digestive powers of a fish become slower in cold weather, and it is probable that between November and March fish eat about two thirds or less of the amount of food eaten during warmer months in spring, summer, and fall. In the examination of the stomach and intestines of Oneida Lake fish it was found that on the

average a fish with a full stomach contained about 115 invertebrate animals. If we assume that this amount is a daily average, and that fish eat this amount for nine months of the year, then the invertebrate animal life on the bottom of the 1164 acres examined in Lower South Bay and vicinity is calculated to furnish food for 337,500 bottom-feeding fish. Predatory fish like the pike perch consume a large number of fish. By using data from Illinois and New York it was estimated that a single fish of this species will eat 250 to 600 small fish in a year. When we remember that there are hundreds of individuals of the pike perch, as well as other predatory fish, in Oneida Lake, it is at once realized that the number of small fish in this lake must be very great to supply these fish with food. It also follows that a large number of invertebrate animals as well as an abundance of vegetation for the smaller animals to feed upon is necessary to provide food for these small fish. It has been shown by these investigations that Oneida Lake meets, in full measure, all of the conditions and requirements favorable to fish and these provide the essentials for a large and varied population of food and game fish.

The studies carried on at Oneida Lake and elsewhere have shown that there are great possibilities in the production of animal life of a useful character to man from the fresh-water streams and bodies of water in our country. The recognition of the value of shellfish and other associated animals which form the food of fish, will lead in the not distant future to the artificial introduction of these animals, as well as needed plants, into waters where they were previously wanting or insufficient in number. If the environment and other factors are favorable there will be no insurmountable difficulties to hinder this procedure. The fresh waters will be cultivated to the extent that the land areas are now worked, as has been the case in parts of Europe, where ponds have been made artificially and stocked with fishes and their food. Food in the form of plants, shellfish, insects, crustaceans, and the like, will be introduced where needed before the fish are planted, paralleling in a way the preparation of the land before the crop is sown. Given a species of fish whose life history and natural history are known, it is comparatively easy to prepare the right kind of habitat and the natural and suitable food. Thus in the course of time we may hope to have a flourishing water culture or aquiculture, so that our streams and lakes may be made productive to the same relative degree that the fields and forests now are. Water culture has the additional advantage of affording healthful recreation to a degree not shared by any branch of agriculture.[1]

[1] Those who may be interested in the details of the studies carried out on Oneida Lake are referred to the following technical papers, published by the New York State College of Forestry at Syracuse University, N. Y.: Publication No. 4. The Relation of Mollusks to Fish in Oneida Lake. 1916; Publication No. 9. The Productivity of Invertebrate Fish Food on the Bottom of Oneida Lake, with Special Reference to Mollusks. 1918; Circular No. 21. The Relation of Shellfish to Fish in Oneida Lake. 1918.



Between Dunham and Frenchman islands in the distance lies a sandy shoal where the water is for the most part less than five feet deep. On this hard, smooth bottom a greater average number of animals was found than in any other part of the lake. This photograph of Oneida Lake is taken from Norcross Point looking northwest

Quest of the Ancestry of Man

TWO institutions have recently been founded to investigate the problems of man's antiquity, human ancestry, and cultural development—the Institut de Paléontologie Humaine, founded in Paris in 1910, and the Galton Society, recently established in the United States with rooms at the American Museum of Natural History.

In founding the Institut de Paléontologie Humaine in 1910, the Prince of Monaco addressed the Minister of Public Instruction as follows: [1]

"In the course of my laborious life I have often regretted that in the intellectual activities of our epoch a more important place has not been given to the study of the mystery that shrouds the origin of man. The more my mind has been stimulated by scientific study, the more ardently I have desired to see established on methodic foundations the investigations necessary to uncover the fugitive traces left by our ancestors in the bosom of the earth during an incalculable succession of centuries. And I thought that the philosophy and ethics of human society would be less uncertain in view of the history of past generations, written in their own remains.

"Therefore, when I had finished establishing the pursuit of Oceanography in the institutions of Monaco and of Paris, I devoted a part of my effort to the search for means which would further the development of Human Palæontology. And, after the foundation of the Museum of Anthropology of Monaco (Musée anthropologique), which was soon enriched with veritable treasures; after the publication of the marvels found in the caverns of Spain; I resolved to establish near some university center a strong foundation for studies based on methodic excavation. Immediately I made choice of the capital of France, where my earlier foundation, the Oceanographic Institute, had already been so largely developed.

"I have selected a site for the building of the Institute of Human Palæontology, and I have selected the first scientists who will direct its scientific undertakings; I have also named an Administrative Council who will control its financial resources.

"I must add that I do not limit the patrimony of the new institute to the building to be erected at Paris: the collections which I have installed at Monaco, although destined to remain there so long as my wishes for their conservation are followed, will become a conditional donation on my part to the Institute of Human Palæontology, to which I have given, for a working endowment, the sum of sixteen hundred thousand francs.

"Being anxious that this foundation should survive me under the most favorable conditions for the advancement of Science, I make request to the French Government to recognize it as a public utility and to approve its statutes."

The Institute is directed, from the technical and scientific side, by a "Comité de Perfectionnement" (Committee of Development), composed of twelve members, either French or foreigners. The members are chosen without distinction of nationality and without observing any especial proportion in the representation of different countries, from among those scientists best qualified to serve. It is to this body that Henry Fairfield Osborn of the American Museum has recently been elected.

The Founder, and, after his decease, the Comité de Perfectionnement, designates—either among its members or outside them—a French scientist to whom it delegates a portion of its powers, and who has the title of Technical Director of the Institute. He receives compensation on account of his responsibilities. The Director is appointed for three years at most and with the possibility of reappointment. The Administrative Council may call upon the Director to attend any of their meetings in an advisory capacity. This office has been held since the beginning by Marcellin Boule, who is also head of the palæontology of the Museum of the Jardin des Plantes, Paris.

The Comité de Perfectionnement fixes the program of work to be undertaken upon the recommendations of the Technical Director, presents to the Administrative Council those scientists who may be attached to the Institute and who will form its scientific person-

[1] Institut de Paléontologie Humaine, Fondation Albert 1er, Prince de Monaco. Statuts, p. 5. Letter of His Serene Highness the Prince of Monaco to the Minister of Public Instruction.

nel, assigns to these their undertakings, and decides upon the proper distribution of the results of excavations among those scientific establishments best qualified to receive them. After consultation with the Administrative Council in regard to ways and means, it decides upon the various publications of the Institute and determines the regulations for the laboratories and libraries.

Under the original organization the Institute selected a number of the most distinguished scientists in France to conduct its explorations and carry on its researches. With a personnel including such experts as Marcellin Boule in palæontology, Verneau in anatomy, and Cartailhac and Breuil in archæology, no surprise can be felt at the brilliant results which are already the fruit of their labors during the few years that have passed since the inception of the Institut de Paléontologie Humaine through the scientific ardor and wise judgment of the Prince of Monaco. NATURAL HISTORY will from time to time publish abstracts and reports of the latest work of the Institute.

It is not an exaggeration to say that the researches and publications of the eight years elapsing since its foundation mark a new epoch in anthropology. On the anatomical side, Boule in a masterly manner has described the Neanderthaloid characteristics in his monograph on *La Chapelle-aux-Saints;* Verneau has studied the skeletal remains of the Crô-Magnon artists in a very complete way, although there is still much to be done on this race; Breuil has covered the marvelous field of palæolithic art of France and Spain and has firmly established the connection between the stages of its development and the respective stages of the flint industry; the relatively unknown period of the Aurignacian flint culture has been fully studied, and Breuil and Obermaier have connected the art of Spain with that of France, and the Aurignacian and "Capsian" culture of Spain with that of Africa.

The Galton Society for the Study of the Origin and Evolution of Man held its first meeting in New York on April 17, 1918, when the object of the Society was outlined and especial emphasis laid on the importance of coöperative effort on the part of specialists, so that the problems to be considered might be studied from widely diverse lines of approach. In addition to the original charter members, comprising Madison Grant, Henry Fairfield Osborn, John C. Merriam, Edward L. Thorndike, William K. Gregory, Charles B. Davenport, George S. Huntington, J. Howard McGregor, and Edwin G. Conklin, there have been added at subsequent meetings the following fellows: Ernest A. Hooton, Peabody Museum; Gerrit Smith Miller, United States National Museum; Raymond Pearl, United States Food Administration; L. R. Sullivan, American Museum of Natural History; Frederick Tilney, Columbia University; Harris H. Wilder, Smith College; Clark Wissler, American Museum of Natural History; and Nels C. Nelson, American Museum of Natural History. Two patrons were elected: Mrs. E. H. Harriman and Mr. M. Taylor Pyne, New York.

At the five meetings so far held significant addresses have been contributed by Professor McGregor, Dr. Wissler, Dr. Sullivan, Professor Davenport, Professor Merriam, and Professor Huntington; and the opportunity afforded for informal mutual discussion of the problems presented already justifies the hopes of its founders that the Galton Society might constitute a symposium of specialists qualified to consider the origin and evolution of man from widely different points of view. The Society has resolved to establish a laboratory to be known as the Galton Laboratory, in furtherance of its objects, and a committee is now considering plans for this project. Many of the members are at present engaged in special investigations within the field of the Society's interests and it is planned that a suitable medium of publication for the scientific and educational documents of the Society shall be secured. A special object of the Society is to encourage the establishment of courses in anthropology in universities, colleges, and other centers of education.

A Letter from John Burroughs

With a question for the palæontologist on evolution

TO THE EDITOR OF NATURAL HISTORY: Dr. W. D. Matthew in his admirable little pamphlet on the Dinosaurs[1] thinks their progenitors in late Palæozoic time were small animals like the modern lizards in size, appearance, and habitat; he adds in a footnote that if "some vast catastrophe should today blot out all the mammalian races including man, and the birds, but leave the lizards and other reptiles still surviving, with the lower animals and plants, we might well expect the lizards in the course of geologic periods to evolve into a great and varied land fauna like the Dinosaurs of the Mesozoic Era."

Is not this an astonishing statement? If Mesozoic times could be brought back and the earth, air, and waters be in every way as they were in that era, this might happen but, in my opinion, not otherwise. Does not the evolutionary impulse run its course? Can or will it repeat itself? It is another world today, from surface to center. Each geologic era had its typical life-forms. The dinosaurs appeared in different parts of the world in the same era, as Doctor Matthew says, and "the cutting off of the Dinosaur dynasty was nearly, if not quite simultaneous the world over." These monsters of the primeval world were highly specialized to meet special conditions, and these conditions can never again return to the earth. We still have reptiles but they are insignificant and cut no figure in the life of the globe. That the huge *Brontosaurus*, for instance, could ever reappear in the Age of Mammals is unthinkable. The Age of the dinosaurs covered about nine million years and its end is now at least three million years behind us. Can we believe that the life of the different periods was as accidental and unrelated as Doctor Matthew's statement would seem to imply?

Might not one as well declare that were our deciduous trees and plants and all exogens swept away, the mosses and ferns and horsetails and ground pines would again produce the tremendous growth of cryptogamous plants that gave us the main part of our coal measures, producing calamites thirty or forty feet high, lycopods sixty to ninety feet high, giant sigillarias, lepidodendrons, and others?

"Amelioration is one of the earth's words," says our poet of the cosmos, Whitman, and it is as true in science as it is in poetry. The earth has developed and ripened, hanging like fruit on the great sidereal tree, and can no more repeat the stages it has passed through, than can any other fruit or growing thing.

[Signed] JOHN BURROUGHS.

Riverby, West Park, New York.

[1] *Dinosaurs.* By W. D. Matthew, Ph.D. December, 1915.

Reply to Mr. Burroughs by Dr. W. D. Matthew

THE footnote to which Mr. Burroughs refers came very near being cut out of the manuscript before it was printed, as a speculative and fanciful supposition that had no place in a brief summary of what is known about dinosaurs. It was left in chiefly because such speculations have for me a certain fascination, and I thought it might be the same way with others. That Mr. Burroughs has picked it out from its lowly position for comment and criticism shows that he, too, finds it of interest.

From the standpoint of the older concepts of cosmic and geologic history his objections are undoubtedly valid. If we believe that the earth has been gradually cooling off during geologic time, the atmosphere becoming less warm, humid, and loaded with carbonic acid gas, the seas cooler, the climate changing from a moist, tropical uniform condition to the cooler, drier, zonal climates that prevail today, then undoubtedly one would conclude that whatever were the ultimate result of the supposititious case I raised, it would not be

the evolution of lizards into a fauna paralleling the dinosaurs.

But these geologic concepts cannot be reconciled with the evidence of glacial periods in the Permian, in the pre-Cambrian, and even farther back in geologic time, nor with various other lines of evidence. The geologic theory, which I outlined briefly in the introductory pages of the Dinosaur handbook, conceives of the physical condition of the earth's surface as passing through a series of cyclic changes in climate, topography, and other factors that constitute the physical environment to which life is adapted, but without any very fundamental permanent change during geologic time. The recurring cycles bring about a recurrence of the physical environment sufficiently identical to condition substantially similar adaptations.

It is of course different with the biotic environment, the fauna and flora, which equally condition the trend and scope of evolution of any one group. This has changed in a generally progressive way, since there are certain factors in adaptation and specialization which operate independently of changing physical environment, certain upward steps that, once attained under its stimulus, are retained as advantageous under all circumstances. The physical environment is cyclic, but the biotic evolution moves in a spiral, reaching corresponding but higher points with each recurrent cycle of climatic change.

The physical conditions at the beginning of the Mesozoic when the dinosaurs arose, were much like those of the present day. The earth had just passed through a glacial period, believed to be quite as intense and widespread as that from which we have just emerged. The continents were extended to or even beyond their present limits, arid climates prevailed widely through their interior as they do now, and probably cold climates at the poles. The atmospheric and climatic conditions cannot have been very different from what they now are; whether the outlines of the continents were substantially the same or not, makes no difference to the problem in hand. The physical environment does substantially correspond at the present time to that under which the dinosaurs arose.

The animals and plants are widely different. The presence of higher types of vertebrates prevents the lizards or any lower vertebrates from expanding into a varied fauna of large land animals as were the dinosaurs. They are unable to compete with the higher types save in certain special fields to which these last are not well adapted. My supposition involved the removal of this competition by extinction of all higher vertebrates, leaving a free field for the lizards such as was open to the lizard-like ancestors of the dinosaurs.

It may well be objected that the evolution of the dinosaurs was conditioned by the nature of the vegetation quite as much as by the competing animal types. The higher types of plant life now prevalent would bring about a different trend and scope of evolutionary progress among lizards in our supposititious case than occurred with the dinosaurs. Probably this objection is valid to some extent, and certainly as to any detailed correspondence. But I do not think it would prevent a marked general correspondence. For the dinosaurs in fact passed through two distinct periods of evolution and expansion, the first in the early Mesozoic, which culminated in the late Jurassic dinosaurian fauna, and the second in the late Mesozoic culminating in the upper Cretaceous dinosaurs.

The first evolution was correlated with a flora lacking the higher plants (angiosperms) now dominant, but the second with a flora very like that of the present day, the herbaceous perennials being the most significant element lacking. These two dinosaur faunas correspond in a broad way; they include armored and unarmored dinosaurs, bipedal and quadrupedal types, great and small carnivorous forms, terrestrial and amphibious adaptations; but similar or equivalent adaptations occur in many cases of different races. There is little correspondence in detail; yet the place they occupied in nature was substantially the same, and there is a great deal of parallelism in their adaptations. We do not find any of the gigantic Sauropoda, *Brontosaurus* and its allies, in this later fauna. But their place as an amphibious adaptation was taken by the wading and swimming trachodonts. The armored dinosaurs of the Cretaceous are like those of the Jurassic only in the fact that they were gigantic and heavily armor-clad. The unarmored herbivorous dry-land dwellers were even more

contrasted in detail. Only in the carnivorous dinosaurs is there any near correspondence and relationship.

It would seem therefore that the evolution of dinosaurian types of specialization is not tied to the more ancient flora, and that so far as this objection is concerned it would not prevent the lizards from evolving in the absence of higher animal types into a varied fauna of large land animals paralleling the Cretaceous dinosaurs in a broad way, although doubtless as different from them in detail as they are from the Jurassic dinosaurs. That they or some other group of lower vertebrates might in the course of further geologic periods give rise to higher types corresponding as to their place in nature to birds, mammals and man is conceivable, but too speculative for discussion. Their limitations in brain, in circulation of the blood, etc., would first have to be overcome, and so far as palæontology can teach us this is a vastly slower progress than the expansive evolution into large specialized and varied faunal adaptations.

Certainly such an expansive evolution of the lizards with their higher competitors removed would not cause the huge *Brontosaurus* to reappear on earth. But it might —if we accept the modern theory of geologic history—bring about the appearance of gigantic wading or amphibious reptiles equally huge and equally innocuous, although probably not at all like a Brontosaur in appearance.

It would seem equally true that under our modern tenets we must be prepared to believe that were all the higher plants swept out of existence the lower plants would proceed under physical environment corresponding to that of the late Palæozoic to evolve into specializations with a broad general resemblance to the Carboniferous flora. They would not reproduce calamites and sigillarias, but they would produce something to take their place, probably no less gigantic and impressive.

This aspect of adaptive evolution receives many illustrations from the fauna and flora of oceanic islands and isolated continents, where, in the absence of certain higher types of animals or plants, certain lower types are evolved and specialized to take their place. The adaptive evolution of marsupials in Australia or of the Tertiary mammals of South America, affords notable instances. Such adaptive parallelism sometimes results in a curiously close imitation or correspondence of particular types; more often the correspondence in habits and in position in the economy of nature leads to a resemblance only in certain parts and a wide difference in other parts of the animal.

[Signed] W. D. MATTHEW.
American Museum of Natural History,
New York City.

Notes

IT is with profound regret that the American Museum records the death, on April 25, of one of its Trustees, Augustus D. Juilliard. Mr. Juilliard, who was senior member of A. D. Juilliard and Company, has been before the public for many years as a patron of art and science. He left several bequests to carry on the work in which he has been personally interested, including a gift to the American Museum of one hundred thousand dollars.

OWING to the lateness in publication and especially to the very greatly increased cost of engraving and printing still effective from war times, the American Museum is combining its last two spring issues of NATURAL HISTORY in this number. Also, because of the prohibitive expense of preparation, it will reduce somewhat the number of pages in the three fall issues, and will omit statements of the institution's work and membership, and advertisement of its publications—except in so far as such matter can be carried on the inside cover pages.

AN account of the library of the University of Louvain and of the sack of the city and the wanton destruction of this ancient collection of manuscripts and books was written and partly printed during the early days of the German occupation, by Ed. de Moreau, S.J., but it has only recently seen publication after lying hidden from the German police four and a half years. The library, with its treasures of manuscripts, incunabula, and literary, historical, and scientific collections which were burned

in the incendiary fire of March 25, 1914, had a long and glorious history. The university itself was founded in 1425 and in the next century ranked as one of the foremost scientific institutions of Europe until suppressed during the French Revolution. In 1913, 2855 students attended the university and it was reported that the library at that time contained 250 incunabula and between 120,000 and 230,000 volumes (M. Moreau quotes the latter figure as too low) in addition to a larger number of manuscripts of ancient and mediæval authors. A movement is under way among the world's universities to rehabilitate the library, but, as M. Moreau says, "The library of Louvain cannot be restored, for the library was formed day by day in intimate association with the history of the University, and this history cannot be restored to it."

The Life of Frederick Courtenay Selous, D.S.O., Capt., 25th Royal Fusiliers, who, according to Roosevelt, was "the greatest of the world's big-game hunters," has recently been written by J. G. Millais. Mr. Millais is himself a noted author, artist, and naturalist, and brings to his task a personal appreciation of the work of Selous. The volume is enriched with a beautiful set of illustrative drawings.

Selous went to Africa at the early age of nineteen, where he resided for the most part until 1897, hunting big game and fighting in the Matebele Wars. His later years he spent lecturing, writing, collecting in Europe and America, and elephant hunting in Africa. In 1915 Selous took part with the Royal Fusiliers in the invasion of German East Africa where he lost his life while leading an attack against the German fort at Behobeho on January 4, 1917. Roosevelt said of him: "No other hunter alive has had the experience of Selous, and, so far as I now recall, no hunter of anything like his experience has ever also possessed his gift of penetrating observation joined to his power of vivid and accurate narration." The biographer has faithfully scanned the public and private writings of the great hunter, especially his correspondence with Roosevelt, for notes on African natural history.

"THE Old Humanities and the New Science" was the subject of the presidential address before the Classical Association (England) delivered by Sir William Osler, regius professor of medicine at Oxford. Sir William, according to *Nature,* pointed out the necessity of a well-rounded education in which would be found a union of science and the humanities. There is, however, he pointed out, a marked need of revision of the present classical instruction at the English universities which should aim to inspire in the student some of the spirit of the classics rather than to raise up a race of philologists.

Sir William also opened at Oxford a loan exhibition of ancient manuscripts and instruments illustrating the scientific history of Oxford. The earliest were two Persian and Moorish astrolabes dated A.D. 977 and 1067. There are exhibited a microscope of 1693, and a slide rule dated 1635 which is probably the oldest in existence.

DR. PATTON in his article in this number of NATURAL HISTORY (page 405) on Thomas Jefferson, the great statesman, who was also the advocate of science and friend of naturalists, makes us admire the force of Meriwether Lewis, the young leader of an expedition across the western plains and mountains to the Pacific. James Lane Allen (page 397) brings to our understanding and sympathy young Alexander Wilson of the same period of pioneer life in America—but we gain no hint of the interlocking of the interests and lives of the two young men. If we follow the young naturalist and the young explorer only a few years further, with just a matter-of-fact statement of events, our interest is not decreased: Wilson desired keenly to go as ornithologist on the expedition with Lewis through the unknown West, but his letter to Jefferson and that of his naturalist friend, William Bartram, for some unknown reason did not bring response. The expedition proceeded (1805) and Wilson remained in Philadelphia. Wilson quoted Lewis in his first volume of *American Ornithology* (1808) regarding the distribution of the blue jay on the Missouri. Lewis returned in honor and became governor of Louisiana. Wilson, at his own expense and alone, made his most difficult expedition through the southern country to New Orleans, on which he contracted disease

which soon was to cause his death. At the last white man's house, on the border of the Indian country, he came upon the story of the tragic end of Lewis (1810), who had been murdered there but a few days before and buried beside the common path. He left money from his small store to build a fence about the grave where the legislature of Tennessee erected the monument in 1848. He returned North most enthusiastic and successful in his work; he worked harder than ever. By 1812 he had published five volumes; in 1813 he finished the seventh; he worked indefatigably on the eighth and last volume because he eagerly saw ahead a revision and perfecting of the whole, but died with it incomplete, in August, 1813.

RELATIVE to Thomas Jefferson (p. 405) and the all-round man, of which we have even in this day of specialization many remarkable examples, it is well for every specialist to take to heart certain recent letters and editorials in the *New York Times*. For instance, Dr. W. W. Keen, of Philadelphia, under date of July 31, writes apropos Stewart's axiom, "No human letters without natural science and no science without human letters." In this connection he gives a brief history of our American Philosophical Society of which we as Americans are proud:

"The policy of the American Philosophical Society, 'held at Philadelphia, to promote useful knowledge,' is most instructive. Founded by Franklin on the model of the Royal Society, which until a relatively few years ago, embraced both the humanities and science, the American society has adhered to the broad original scope, and still embraces both letters and science. Among our members we include philologists, historians, archæologists, statesmen, lawyers, etc., as well as astronomers, physicists, chemists, physicians, etc. From the ranks of the society have been chosen eight presidents of the United States, and Thomas Jefferson was our president during all his eight years as President of the United States, and for ten additional years—a unique record as a society."

THE tooth of a mammoth has been presented to the American Museum by Dr. A. K. Kouznetsov, Director of the Museum of the Russian Geographical Society at Tchita, Siberia. Dr. Kouznetsov, who extended this expression of cordiality through Mr. Franklin Clarkin on the occasion of the retirement of American agents from that district, says in his message that he is the oldest political exile in Siberia, having served a fifty-year sentence, and that he hopes if he survives the threatened annihilation of all *intelligentsia* by the Bolsheviki he will see in Russia a democracy patterned after that in America.

Many bones of the mammoth and other extinct animals are found imbedded in the impervious clay in the gold mines of the province (Transbaikalia) of which Tchita is capital. Farther to the north in the province of Yakutsk the famous discoveries were made of mammoths preserved intact by the cold in crevices. One of these mammoths, taken out in 1801, is the well-known skeleton set up in the zoölogical museum in Petrograd. Dr. Kouznetsov is of the opinion that it had stood less than two thousand years in the ice. Its skin and long hair were in fairly good condition and its flesh was eaten by the dogs of the party. Dr. Kouznetsov reports that the natives of Yakutsk Province are selling every year two thousand pounds of mammoth tusks to be used for ivory imitation.

THE report for 1918 of the "Explorations and Field-Work of the Smithsonian Institution"[1] reveals extensive work, in spite of the war, in the fields of anthropology, archæology, geology, botany, zoölogy, and astrophysics. The institution is rapidly collecting records of the languages, customs, and traditions of the American Indian tribes. The astrophysical observations at Mount Wilson on the accurate measurements of solar radiation have been continued. A station was also established at Calama, Chile, as the most cloudless spot on the earth for simultaneous observations. By this work it is hoped to lay a foundation for the application of such accurate measurements to the forecasting of terrestrial temperature changes. Botanical exploration was carried on in Ecuador and in the southwestern United States; and other expeditions for general collecting were sent to the French Congo, and to Borneo and Celebes.

Two initial volumes have appeared of what will be a most notable series of "Monographs on Experimental Biology,"

[1] *Smithsonian Miscellaneous Collections*, Vol. 70, No. 2.

edited by Jacques Loeb, head of the department of experimental biology in the Rockefeller Institute, T. H. Morgan, professor of experimental zoölogy in Columbia University, and W. J. V. Osterhout, professor of botany in Harvard University. The two volumes which have so far appeared are *Forced Movements, Tropisms, and Animal Conduct*, by Dr. Loeb, and *The Elementary Nervous System*, by G. H. Parker, professor of zoölogy in Harvard.

In connection with the illustration of mastodon bones collected by Thomas Jefferson at Shawangunk, Ulster County, New York (see page 407), it is interesting to recall that both Ulster and Orange counties have been prolific in mastodon remains. After the recession of the transcontinental glacier, large marshes were left in this region where these huge animals frequently became mired. The most perfect skeleton so far unearthed, the "Warren mastodon" now in the American Museum, was taken out near Newburg, in 1845. This skeleton together with the "Shawangunk skull" was purchased and described by Professor John Collins Warren, of Harvard, in his famous memoir, *The Mastodon Giganteus of North America* (1852). Farmers in these counties are frequently turning up bones in a greater or less state of decay, which they not infrequently take for pieces of tree stump. Remains of mastodon hair also have been reported from Ulster County, "of dark, golden brown color, long, dense and shaggy."

Recently preliminary reports on the scientific work of Rasmussen's Second Thule Expedition have been printed by the Danish Geographical Society. An ancient folded range (probably palæozoic) was discovered extending from Robeson Channel along the whole north coast of Greenland into Peary Land, probably continuous southward with the range in Grinnell Land. It was found that the great ice-free highlands of the inland ice belt, which the expedition crossed on its return journey, are entirely devoid of higher forms of vegetation. With reference to the evidences of Eskimo occupation, especially at Independence Bay, Mr. Rasmussen is of the opinion that it would never have been possible for Eskimo to migrate from the west along the northern coast to the point where the expedition found tent rings, and that accordingly these remains indicate migration northward along the eastern coast.

The Fisheries of the North Sea[1] has been written to inspire a greater appreciation of "our magnificent heritage of the sea." It gives a sketch of the history of the fishing industry of these northern waters from the time of primitive bone hooks to the modern steam trawler. The book contains much useful information on the industry in Scandinavia, Holland, Germany, France, Russia, and America. We are all fully awake after the late war to the economic and naval importance of the subject.

The total eclipse of the sun which occurred on May 29 was notable for its duration—5 minutes in Brazil, and 6 minutes 51 seconds on the Atlantic Ocean. The eclipse was visible in Bolivia and Brazil, South America, and in the French and Belgian Congo, and Mozambique, Africa.

More than one thousand contributions for the Roosevelt Memorial Bird Fountain to be erected by the National Association of Audubon Societies of the United States, had aggregated $11,684.19 on May 1. It is estimated that $100,000 will be needed to make the memorial a fitting monument to the memory of the great naturalist president.

The summer course of the Marine Biological Laboratory, Woods Hole, Massachusetts, enters on its thirty-second year. A new department, Protozoölogy, is added, and Professor Gary N. Calkins, of Columbia University, offers a formal course in this subject for advanced students. The faculty of the investigation branch of the botany department has also been expanded by the addition of Edward M. East, professor of experimental plant morphology in Harvard, Robert M. Harper, professor of botany in Columbia University, E. Newton Harvey, assistant professor of physiology in Princeton University, and Winthrop J. V. Osterhout, professor of botany in Harvard.

The summer courses at the Cold Spring Harbor Biological Laboratory are adapted to both elementary and advanced students, and facilities are granted as usual to stu-

[1] *The Fisheries of the North Sea*, by Neal Green. London, Methuen & Co., 1918.

dents wishing to undertake original investigations. Associated with Dr. Charles B. Davenport, director of the laboratory, is a large staff, including Professors Herbert E. Walter, field zoölogy, Henry S. Pratt, comparative anatomy, John W. Harshberger, plant geography and ecology, and Harris Hawthorne Wilder, physical anthropology.

THE Carnegie Institution of Washington reports for the year 1918 a transference of many of its activities into war channels for both the Institution as an organization and for the individual members of the staff, many of whom were temporarily drawn from their regular duties for special government service. Most of the big war tasks the Institution had in hand were still confidential at the time President Woodward submitted his yearly report and so are not included, with the exception of the organization of an optical glass industry by the Geophysical Laboratory. Most of the high grade optical glass used in this country before the war had been imported from Europe. Not only was this supply cut off, but the entrance of the United States into active military participation entailed an increased demand for all sorts of optical instruments. The Geophysical Laboratory at the request of the government undertook to investigate the processes underlying this industry and then assumed the direction of establishments built for manufacturing the glass. As a result of their work the output of uncut optical glass in the country was increased from one to one hundred tons a month.

The continuation of the regular scientific work of the Institution, however, was not entirely interrupted. Even the menace of German raiders did not keep the nonmagnetic ship "Carnegie" in port throughout the year. The magnetic surveys of the "Carnegie" have carried her over 189,176 nautical miles, more than eight times the circumference of the earth. The service of this survey to navigators cannot be overestimated, for even slight errors in compass bearing may prove disastrous to a ship relying on an erroneous chart. In places in the South Pacific, the errors in magnetic variations of the best charts were discovered to be as much as 16 degrees.

At the beginning of 1918 there was incorporated into the Carnegie Institution the Eugenics Record Office at Cold Spring Harbor, Long Island, founded by Mrs. E. H. Harriman. This office has been serving as a clearing house and repository for eugenical records and as a training school for field workers in connection with the summer course given at the Harbor by the Brooklyn Institute of Arts and Sciences. A large number of bulletins and several memoirs on subjects of heredity and eugenics had been published and the office had accumulated nearly 52,000 pages of first-hand manuscript data before coming under the control of the Carnegie Institution.

It is interesting to note that 372 volumes of scientific researches have so far been published by the Carnegie Institution, not to mention the many articles and books printed elsewhere by its investigators.

COLOR patterns of fishes with reference to the habits and environment of the species have been the subject of intensive studies conducted during the past year in the Hawaiian Islands by Professor William H. Longley under the auspices of the department of marine biology of the Carnegie Institution. Professor Longley made most of his observations under water by means of an equipment of diving-hood and submarine cameras, remaining at considerable depths for as long as four or five hours at a time. Also he has been carrying on experiments in submarine color photography, and reports that he is convinced of its possibility, although a special color screen is required to stop more of the shorter light waves than does the customary screen.

ONE of the first results of the war, in England and America at least, is exaltation of what is national, and one of the earliest reactions is a turning to peaceful out-of-door sports and quiet country living and travel. It is safe to prophesy that Americans will now know America far better than ever before, and will understand and appreciate as never before the fundamental facts of the natural history of America, especially of physiography, geology, archæology, and of course of plant and animal life. There promises to be available a most remarkable abundance of authentic literature on natural history subjects.

Probably the greatest movement on foot in America along this line results from the organization of the "National Parks Asso-

GRAND CAÑON, THE WORLD'S GREATEST EXAMPLE OF STREAM EROSION

Model of part of the Bright Angel section prepared at the American Museum. Horizontal scale, 1000 feet to the inch; vertical, 500 feet to the inch. (This exaggeration counteracts the flattening effect which results from having the eye of the visitor (standing before the low model) at a comparatively great altitude, as if looking from an aëroplane about 24,000 feet above the famous El Tovar Hotel.)

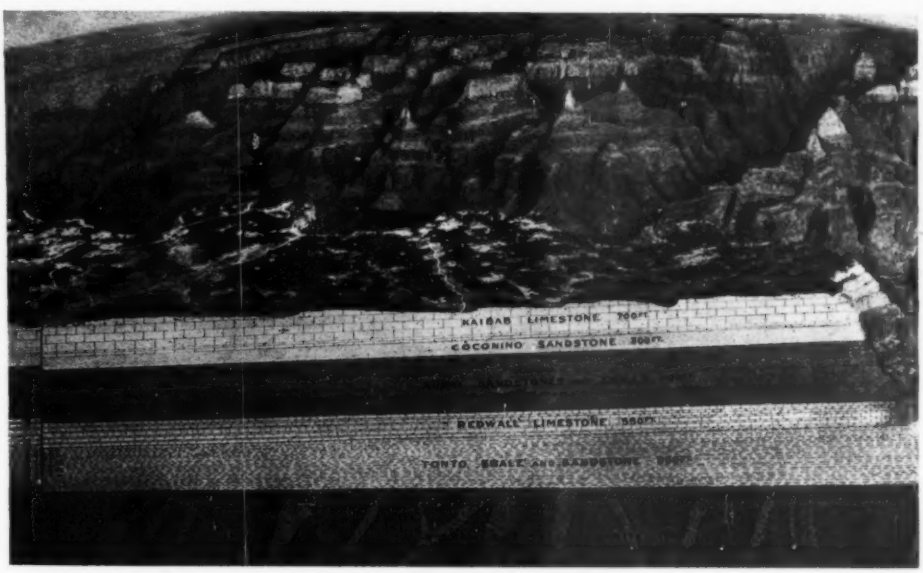
Method of Preparation.—The primary object was to show topography and geology, purely artistic results were secondary in importance. The topographical map of the United States Geological Survey was enlarged by photography four diameters. The chosen contour lines of the map were then transferred by means of impression paper to boards of the proper thickness to give vertical distances of 100 feet between contours. These boards were then sawed along the contour lines, and the resulting pieces glued and nailed one on top of another in the proper order, forming a reproduction of the map in relief. The core thus built up was coated with a modeling composition which could be moulded and carved into shape to represent the actual surfaces of ground and cliffs as nearly as possible. During the progress of the task the modeler made a special trip to the Grand Cañon to gain first hand data, including color sketches for surface and sky. When the modeling on the core had been completed a plaster cast was made, the surface was retouched, and the whole colored in accordance with the studies from nature. The background was then painted, with "flies" similar to those used in theatrical scenery to heighten the pictorial effect.

The preparation of the model, begun under the direction of Chester A. Reeds and completed under that of E. O. Hovey, was carried out by P. B. Hill, E. J. Foyles, A. Brickner, and A. Latzko. Modeling, coloring, and background are by Morgan Brothers

ciation." It is outside of the United States Government, independent of the National Park Service; it will work in coöperation with the Government but "untrammeled by precedents and polities"—the Service to develop the parks, the Association to educate the people for the higher enjoyment of the parks. Space will not permit quotation of the long lists of representatives of travel clubs and scientific societies, of universities, and of influential individuals, but to one interested in the results these lists are encouraging in the national importance of the included authors, journalists, educators, geographers, geologists, explorers, conservationists, publicists, artists, etc. About twenty universities are represented in the Association by their presidents.

America's numerous national parks are to be utilized as a "People's University of Natural Science," where a half million or more in attendance may study the natural history of our country and the formative processes that have given the continent its physical characteristics. Our national parks have been viewed largely as scenic wonders: "National Park" should be a trade-mark for conspicuous grandeur and majestic beauty, but it should also represent a standard of out-of-door living and natural history appreciation. The Association therefore will try to function as interpreter, a medium through which scientific knowledge may be made available to the general public, and it is greatly hoped that the various universities will coöperate by sending classes and instructors to the parks, allowing credits toward a degree as in regular course work.

The National Park Service of the Department of the Interior through its Educational Committee has been carrying on preliminary work of this nature in coöperation with the Commissioner of Education. Publications have been introduced into the schools and one series of pictures sent out for public exhibition. The Director of the Forest Service has emphasized the importance of this work in his annual report, expressing his desire to see its wide extension. "I want to see pictures of American mountains, geysers, glaciers, and cañons in every classroom of geography in the land; I want to see the beautiful pictures of national park scenes placed in the schoolhouses with portraits of national heroes and views of historic places; I want to see textbooks in certain subjects made more truly American by referring to features in our national park system rather than to similar objects in foreign lands."



Detail of the Grand Cañon model in the American Museum, showing the geological section as given on its front. The names appearing on the beds of rock are those which have been applied to the groups of rocks by the geologists who have made special studies of the region: The bed of the Vishnu gneiss and granite at the base is of Archæan age, the oldest in the geological series, and its approximately flat top indicates the elapse of a vast period of exposure and erosion before the Tonto shale and sandstone began the series of sedimentary rocks above—which form the principal features of the cañon

Photograph by Trevor Kincaid

The summer laboratory of the Puget Sound Biological Station, connected with the University of Washington, is situated just above high tide at Friday Harbor. Pipes laid deep in the channel supply fresh and sea water at a constant temperature to all individual research rooms. The tides rise about twelve feet at this point, rushing through the channels of Puget Sound, thus keeping the local water well aërated for marine life. For facts regarding the work in fisheries at the University of Washington, see the article, in this number, by Dr. Hugh M. Smith, United States Commissioner of Fisheries

A NOTABLE out-of-door natural history course is offered this summer of 1919, by the University of California, in the form of the Le Conte Memorial Lectures in the Yosemite Valley. These lectures will be delivered in localities in the valley which illustrate the physiographic subjects under discussion. They include three series covering the botany, geology, and ethnology of the region. A fourth series, on John Muir, will be given by Professor W. F. Bade.

Far Away and Long Ago,[1] by W. H. Hudson, the British and South American naturalist and author, gives us a glimpse into his early life on the pampas of Argentine where he spent his boyhood, keenly observing the wild things of the plains. Mr. Hudson writes in a reminiscent spirit more to express the joy he found in living in the great outdoors than to give an autobiography. "When I hear people say," he writes, "they have not found the world and life so agreeable or interesting as to be in love with it—I am apt to think they have never been properly alive nor seen with clear vision the world they think so meanly of. . . . "

[1] *Far Away and Long Ago: A History of My Early Life.* By W. H. Hudson. London and Toronto, 1918.

THE University of Montana is holding for the nineteenth season its six weeks' outdoor courses in geology, botany, and zoölogy at the Biological Station on Flathead Lake. As in previous years the students camp at the lake in tents provided by the university. Outdoor, laboratory, and lecture courses are offered and opportunity afforded for individual research. Morton J. Elrod, professor of biology, Paul W. Graff, assistant professor of botany, and Roy Wilson, instructor in geology, all from the state university, constitute the scientific staff.

A FIELD course in anthropology is being offered for six weeks during July and August by the University of Arizona. The work will take the students over the Navajo Reservation and the homes of the Pahute and the Hopi Indians, and visits will be made to the Grand Cañon of the Colorado, the Painted Desert, Monument Park, and the Nonnézoshie (Rainbow) natural arch. Students undertaking this work must be able to ride horseback and will have to be prepared to spend most of the time tramping and camping on the desert. As a scenic trip the route cannot be excelled; it is also one of the best localities of the country in which to study both the ruins of the cliff dwellings and contemporary Indian tribes.

A DEPARTMENT of forest recreation has been established at the New York State College of Forestry to undertake investigation and instruction in the proper use of the public forest reserves for recreation. Prof. Henry R. Francis has accepted this chair and will give his attention to the forest and park areas of the state with reference to their playground possibilities. This is the first department of the kind to be established in a school or college in this country.

THE State Ranger School of the New York State College of Forestry undertakes to train men to fill positions in the field of work between that of the lumberman and the professional forester. The school is located at Wanakena in the Adirondacks. Practical forest work is emphasized and a nursery is maintained where many thousands of trees are produced annually.

THE Bureau of the Associated Mountaineering Clubs of North America in its recent bulletin for 1919 proclaims a wide interest in the pleasures of outdoor recreation among America's forests and mountains. Twenty-nine different clubs, societies, and institutions compose the Bureau, comprising most of the organizations of this country and Canada which are actively interested in the protection and development of the scenic treasures of America. They are: American Alpine Club, Philadelphia and New York; American Forestry Association, Washington; American Game Protective Association, New York; American Museum of Natural History, New York; Adirondack Camp and Trail Club, Lake Placid Club, N. Y.; Appalachian Mountain Club, Boston and New York; Boone and Crockett Club, New York; British Columbia Mountaineering Club, Vancouver; Colorado Mountain Club, Denver; Field and Forest Club, Boston; Forest Service, U. S. Dept. Agriculture, Washington; Fresh Air Club, New York; Geographic Society of Chicago; Geographical Society of Philadelphia; Green Mountain Club, Rutland, Vermont; Hawaiian Trail and Mountain Club, Honolulu; Klahhane Club, Port Angeles, Wash.; Mazamas, Portland, Oregon; Mountaineers, Seattle and Tacoma; National Association of Audubon Societies, New York; National Parks Association, Washington; National Park Service, U. S. Dept. Interior, Washington; New York Zoölogical Society, New York; Prairie Club, Chicago; Rocky Mountain Climbers Club, Boulder, Colorado; Sagebrush and Pine Club, Yakima, Washington; Sierra Club, San Francisco and Los Angeles; Tramp and Trail Club, New York; Wild Flower Preservation Society of America, New York.

The current bulletin of the Bureau announces an International Congress of Alpinists, called by Baron F. Gabet, vice president of the French Alpine Club, to meet in Monaco, May 10–16, 1920. The proceedings of this congress, to which the National Park Service will contribute, are to be published.

AT the annual meeting of the American Camp Directors' Association and the Woodcraft League of America, held at Greenkill Camp near Kingston, New York, in May, Prof. George L. Meylan, of Columbia University, gave a vivid account of his work abroad in introducing athletic games in our armies and in those of France. Demonstrations in woodcraft were in charge of Ernest Thompson Seton, and of campcraft in charge of Dillon Wallace, the Labrador explorer. Bird study was conducted by Dr. G. Clyde Fisher, representing the American Museum.

THE "Roosevelt," Admiral Peary's ship which made possible his discovery of the North Pole, is called to mind in connection with the recent death of Eugene D. Hawkins. It was Mr. Hawkins who in 1904 favorably presented Peary's projects to his client, the late George Crocker, with the result of a prompt subscription of $50,000 for the ship and expedition.

ONE New York artist's impression of the recent exhibition at the Brooklyn Museum of relics of the whaling industry on Long Island is as follows: "The little collection contained many instructive things connected with this once flourishing industry. Chief among them from the artist's point of view were the numerous pie-markers artistically wrought from pieces of sperm whale teeth or bone. The ingenuity displayed by the rough whalers who made these little tools for the kitchen is truly remarkable, but the artistic side of the work is even more worthy of notice. One sees here how successfully

such homely objects may combine usefulness and beauty: a charming object lesson to students of design in household furnishing."

PRESIDENT HENRY FAIRFIELD OSBORN has recently been elected to one of the trusteeships of the Institut de Paléontologie Humaine of Paris, as a member of the Conseil de Perfectionnement. In announcing his election, Director Marcellin Boule writes: "Il a voulu reconnaître ainsi, non seulement les éminents services que vous avez rendus à la Science, mais encore la sympathie que vous avez montrée à nos préhistoriens en écrivant votre bel ouvrage sur les Hommes de la pierre. . . . Je suis heureux d'avoir le privilège de vous annoncer cette nomination. Elle ne peut que resserrer les liens d'amitié qui unissent votre pays au nôtre, et qui nous unissent personnellement."

A DINNER was given in honor of Dr. N. L. Britton, director of the New York Botanical Garden, by the managers of the Garden on May 7. The organization of the work twenty-three years ago and its subsequent success were reviewed, and Dr. Britton was presented with a loving cup on behalf of the board of managers.

A PLAN is being carried out for the improvement and development from a scenic standpoint of the forests and open lands along the Du Pont Road in Delaware. This road, which forms a part of the Lincoln Highway, extends throughout the length of Delaware and in its improved form will be a great asset to the state. It is two hundred feet wide, with roadbed of cement. The right of way was presented to the state by Mr. E. C. Du Pont, who also financed the undertaking of its development. The upkeep and control of the road, forty miles of which already have been completed and opened to travel, are in the hands of the State Board of Agriculture. Mr. George B. Sudworth, dendrologist of the United States Forest Service, recommended the plan for making the highway scenically attractive by planting forest trees along the roadway to supplement and improve natural woodland effects. At several places cleared lands are to be planted with fruit trees, and various horticultural and agricultural projects will be undertaken as object lessons in practical farming. Incidentally the excellent roadway makes it possible to carry harvested crops easily and quickly to markets.

THE AMERICAN SOCIETY OF MAMMALOGISTS has been organized in Washington. The Society will be devoted to the general problems involved in the study of mammals, their evolution, behavior, and life histories, as well as to systematic and anatomical studies. More than two hundred and fifty were enrolled as charter members. The following officers were elected: C. Hart Merriam, president; E. W. Nelson, first vice president; Wilfred H. Osgood, second vice president; H. H. Lane, recording secretary; Hartley H. T. Jackson, corresponding secretary; Walter P. Taylor, treasurer; N. Hollister, editor. Glover M. Allen, R. M. Anderson, J. Grinnell, M. W. Lyon, W. D. Matthew, John C. Merriam, Gerrit S. Miller, Jr., T. S. Palmer, Edward A. Preble and Witmer Stone were elected councilors.

DR. J. A. ALLEN, curator of the department of mammalogy and ornithology at the American Museum, has been elected the first honorary member of the newly formed American Society of Mammalogists.

THE history of science in England and in America has been reviewed in two recent books[1] by notable scientists of the two countries. The work on American science by Professor Dana, and by other members of the Yale faculty, for the most part was published to commemorate the one hundredth anniversary of the founding of the *American Journal of Science*. The general progress of science through the century, especially as illustrated by the *Journal*, is depicted in chapters devoted to special fields. The first chapter, written by Professor Dana, is an account of the *Journal* itself and its various vicissitudes in the hands of Professor Silliman and his successors. In its inception the *American Journal of Science*, as the first American scientific magazine, aimed at a very comprehensive program "to advance the interests of this rising empire by exciting and concentrating original American effort, both in the sciences and in the arts." No

[1] *A Century of Science in America with special reference to the American Journal of Science 1818–1918.* By Edward Salisbury Dana, *et al.*
Britain's Heritage of Science. By Arthur Schuster, F.R.S., and Arthur E. Shipley, F.R.S., London, 1918.

better means of measuring the scientific advance of the century and the country could be found than the pages of this *Journal* which has been the fortunate publisher of some of the most notable scientific discoveries of the time.

The greater part of the volume is devoted to geology, mineralogy, and palæontology to which the *Journal* has been especially devoted, but there are in addition chapters on chemistry, physics, zoölogy, and botany.

The British work by the secretary of the Royal Society and the vice-chancellor of Cambridge undertakes "to give a plain account of Britain's great heritage of science," from Roger Bacon to the present. The authors have treated their subject as a series of biographies presenting the main facts concerning the lives and discoveries of distinguished British scientists. On the whole the work does not aim to include accounts of living scientists, although exceptions have been made in certain cases. Both volumes are illustrated with numerous portraits.

DR. W. D. MATTHEW, curator of vertebrate palæontology of the American Museum, has recently been elected a Fellow of the Royal Society of Great Britain. The citation accompanying his election is as follows:

"A Canadian palæontologist distinguished for his valuable contributions to our knowledge of the fossil mammals of North America, and his philosophical discussions of the modern results of vertebrate palæontology. By geological research in the field he has helped largely in the more exact determination of the relative ages of the fossils occurring in the Tertiary rocks of western North America. He has also done much to popularize vertebrate palæontology and to spread a general interest in the subject. Author of numerous memoirs and papers, among which may be enumerated:—*Revision of the Puerco Fauna* (1897); *Fossil Mammals of the Tertiary of N. W. Colorado* (1901); *Hypothetical Outlines of the Continents in Tertiary Times* (1906); *Osteology of Blastomeryx and Phylogeny of the American Cervidæ* (1908); *Carnivora and Insectivora of the Bridger Basin* (1909); *Phylogeny of the Felidæ* (1910); *Revision of the Lower Eocene Wasatch and Wind River Faunas* (1915–16), (*Bull.* and *Memoirs*, Amer. Mus. Nat. Hist.); *On Certain Theoretical Considerations Affecting Phylogeny and Correlation* (1914), (*Bull.* Geol. Soc. Amer.); *Climate and Evolution* (1915), (*Annals*, New York Acad. Sci.)."

This citation is signed by three of the most eminent palæontologists of Great Britain, namely: A. S. Woodward, C. W. Andrews, and H. Woodward, of the British Museum; also by E. S. Goodrich, of Oxford, Oldfield Thomas, of the British Museum, and G. Elliot Smith, the anatomist.

Two handy pocket manuals of common woody plants have been published during the last two years by Professor William Trelease,[1] of the University of Illinois, comprising admirable keys to the trees, shrubs, and woody climbers in eastern United States and northern Europe during both winter and summer. Most of our manuals use fruit and flower characters for the basis of their keys, making it impossible to identify the plants throughout the greater part of the year, but Professor Trelease has based his first book, *Plant Materials*, as he says, "in large part on differences used by the old herbalists,—position and other peculiarities of foliage," and the second volume, *Winter Botany*, in a similar manner on leaf scar and bud differences. For the man who wishes an introduction to some of the delights of out-of-doors, as well as for the entomologist who wishes to determine the habitat of certain larvæ, for the mycologist identifying the host of his fungus specimens, for the gardener in winter, and for the amateur or even professional botanist, these little volumes will always prove valuable guidebooks in the field.

THE great change which has come in the literature and art of Chile since the beginning of the twentieth century was emphasized by Sr. Enrique Molina, director of Concepción High School, in a lecture at Columbia University. Chilean literature especially has become both more national and better appreciated throughout the country so that it is now possible for an author to live by his profession. Chile has made notable educational advances during recent years and particular attention to the building of schools is being given by the present government under President Sanfuentes.

A VERY valuable exhibition in late spring at the Metropolitan Museum of Art, New York, illustrated plant forms historically used in design, and called attention to the

[1] *Plant Materials of Decorative Gardening*, Urbana, 1917, and *Winter Botany*, *ibid.*, 1918.

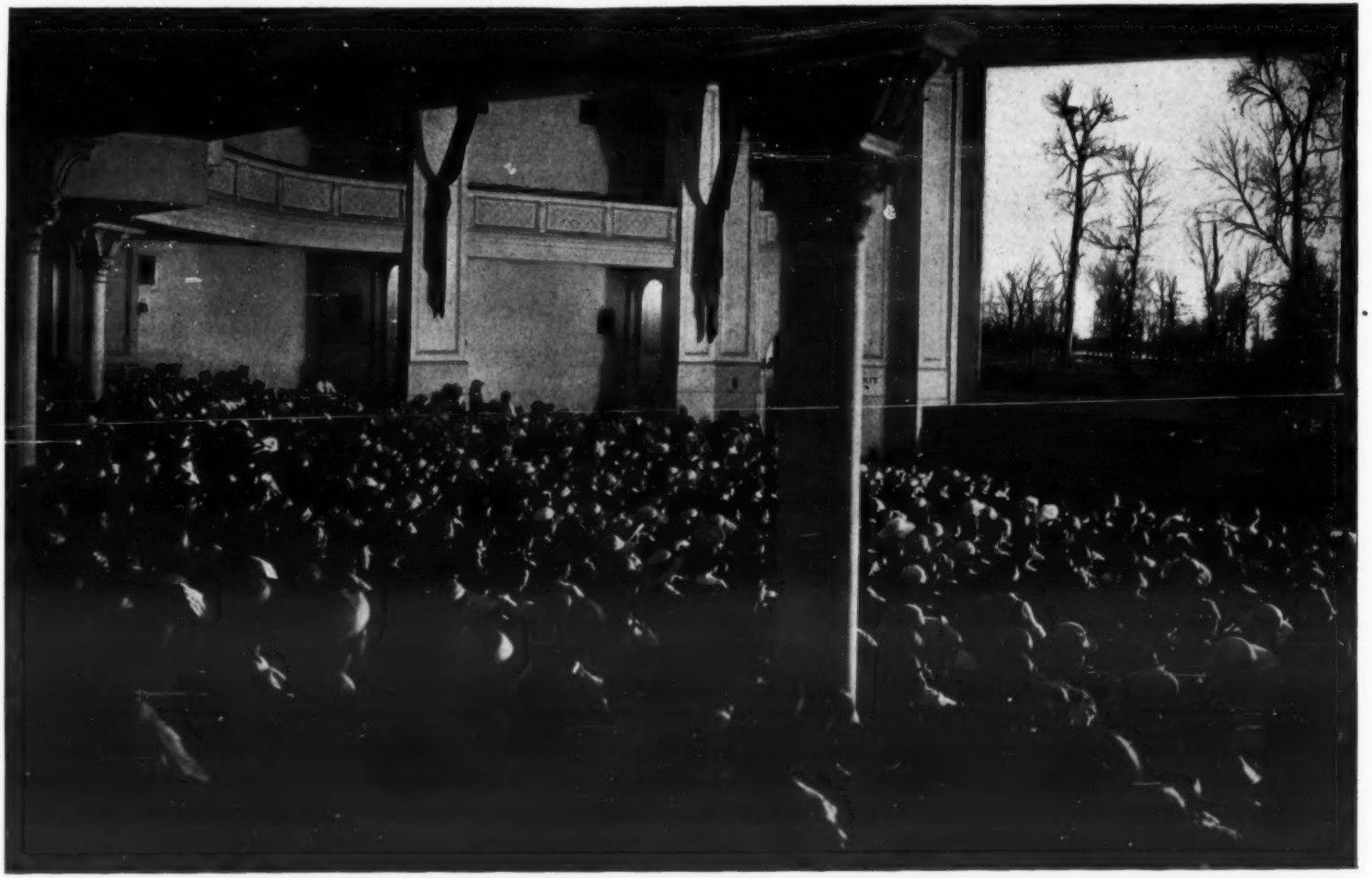
possibilities in the use of American plant subjects for new ideas in design. A collection of native and exotic objects of art, tapestries, china, wood carving, and architecture was arranged in connection with examples of living plant forms which contributed their dominant motives,—such as acanthus and papyrus, lotus, grape, cypress, and almond.

THE American Museum was represented at the fourteenth annual meeting of the American Association of Museums, held in Philadelphia in May, by Messrs. E. O. Hovey, Herbert J. Spinden, and Roy W. Minor. Dr. Spinden addressed the session with reference to the utilization of museum material in industrial art. He explained the extensive adaptations by textile manufacturers of decorative motives found among North and South American Indians and the more primitive peoples in other parts of the world. Anthropological collections make available many old ideas that can be put to modern use. The commercial success along this line of development has already been great. For the first time American houses have been able to market silks and ribbons in both Paris and London in competition with European designers. The problem before America is to develop an everyday art that properly expresses our nationality. Dr. Spinden's paper aroused a lively discussion.

THE value of the educational work which the American Museum is doing for the public schools of New York City is emphasized by the recent action of the Board of Education in providing a special appropriation which will enable the institution to extend its full-time service to the schools during the current year. This service to the schools is quite outside the terms of the contract between the Museum and the City: consequently, when the Board of Estimate reduced the appropriation for the maintenance of the Museum in 1919, the trustees were compelled to suspend activities which were not provided for in the letter of the contract. Under the limited program provided, the Museum was obliged to discontinue supplying nature-study collections to the schools of the Bronx, Brooklyn, Richmond, and Queens, to reduce the lectures for school children to half the number, and to discontinue entirely the circulating collections for public libraries. President H. F. Osborn, of the American Museum, brought the situation to the attention of members of the Board of Education at a conference held in the Museum on February 18, 1919, at which President Arthur S. Somers, Mrs. Ruth F. Russell, and Dr. Gustave Straubenmüller represented the Board of Education, Professor Stephen P. Duggan, the College of the City of New York, and President Henry Fairfield Osborn, Director Frederic A. Lucas, Mr. George H. Sherwood and Dr. G. Clyde Fisher, the American Museum. As a result of this conference, at which the various phases of the Museum's activities with the schools were presented and discussed, the Board of Education, at the request of President Somers, made a special appropriation of $4,100 to enable the Museum to resume its full-time service to the schools.

DURING the past winter and spring the auditorium and other assembly halls of the American Museum have been in almost daily use for lectures or meetings of scientific societies. At the autumn course for members Mr. Branson M. DeCou lectured on the Colorado, Yellowstone, and Glacier National Parks; Mr. T. Gilbert Pearson on the United States bird reservations; Mr. Charles Crawford Gorst on bird music; and Mr. Graham Lusk on the food supply of the Allies. For the spring course Mr. Carl E. Akeley lectured on Africa; Mr. George D. Pratt on the forests and wild life of New York; Professor Herbert E. Gregory on Australia; and Dr. G. Clyde Fisher on a naturalist's rambles in Florida. The children's course included two series of four lectures each on wild birds and animals, the Eskimo, Indian stories, and the winds. For the children of the public schools four courses of six lectures each were offered by members of the Museum staff on the industries of the United States, natural history, early history of America, and geography respectively.

In addition to these regular courses a number of special lectures have been delivered at the Museum from time to time. Professor S. A. Mitchell spoke in December on "The Result of the Eclipse of 1918"; Dr. Lindley M. Keasbey in January gave three lectures on "Wealth and its Ways"; and Mr. John Kendrick Bangs lectured on "Light and Shade in the Land of Valor." On February 5, Sir Arthur Pearson, the blind



PUBLIC LECTURES ARE ONE OF THE AMERICAN MUSEUM'S IMPORTANT EDUCATIONAL FEATURES

Not only members of the American Museum but also large numbers of primary and high school children and of the general public are reached by the lectures given in the auditorium. This photograph shows Dr. G. Clyde Fisher addressing an audience of school children, with the assistance of stereopticon views of the local birds. The auditorium has a seating capacity of 1400 and is well equipped for presenting stereopticon slides, and especially moving-picture reels, of which the Museum now possesses a valuable and rapidly growing collection

founder of St. Dunstan's Hostel, London, addressed seven hundred New York blind and their friends. This spring a special course of travel lectures was arranged for visiting soldiers and sailors who were addressed on three occasions by Messrs. Carl E. Akeley, George H. Sherwood, and James Barnes.

The small assembly rooms of the Museum have served as meeting places and lecture halls for the New York Academy of Sciences and affiliated organizations, which include the Linnæan Society of New York, the New York Mineralogical Club, New York Entomological Society, Torrey Botanical Club, New York Microscopical Society, and the American Ethnological Society. Special lectures were arranged by the educational department of the Museum for several of the city's high schools, the Ethical Culture School, art classes, the School Nature League, and the Boy Scouts.

THE following persons were elected members of the American Museum during the months of April and May:

Patron, MRS. HENRY FAIRFIELD OSBORN.

Fellow, MR. S. N. BOND.

Life Members, MRS. HAROLD F. MCCORMICK, MISSES E. M. KITTREDGE, ISOBEL H. LENMAN, DR. PEARCE BAILEY, MESSRS. JOHN EDWARD ALDRED, JOSEPH C. BALDWIN, JR., EDMUND G. BUCKNER, C. L. CARPENTER, WALTER S. CASE, FRANCIS B. CROWNINSHIELD, J. S. CULLIN. N HEYWARD CUTTING, WILLIAM DU PONT, W. CAMERON FORBES, HENRY S. HALL, JR., REYNOLD JANNEY, FAIRFAX S. LANDSTREET, JOHN M. MOREHEAD, HOWARD PHIPPS, HERBERT L. PRATT, DANIEL G. REID, FRANCIS BEACH WHITE, WILLIAM WHITMAN and GEORGE WOOD.

Sustaining Members, MRS. CARL FERENBACH, MESSRS. R. J. CALDWELL, WALLACE DE WITT, WILLIAM B. GOODWIN, ELON HUNTINGTON HOOKER, G. B. MCCANN and EDWARD MILLIGAN.

Annual Members, MESDAMES HEZEKIAH A. BRAYTON, S. B. BROWNELL, C. N. EDGE, HERBERT SPENCER GREIMS, CLEMENT ACTON GRISCOM, H. HARDINGE, FRANKLIN S. HENRY, ROBERT I. JENKS, WOLCOTT H. JOHNSON, LEO LORENZ, F. MAURICE NEWTON, JAMES F. SHAW, FAYETTE SMITH, MISSES ANNE HAMPTON BARNES, MARY F. BARTLETT, IDA M. HARRIS, BESSIE NATHAN, MARTHA R. WHITE, REAR ADMIRAL C. MCR. WINSLOW, U.S.N., DOCTORS ALICE G. BRYANT, ROBERT GOOD, THOMAS HOWARD GROSVENOR, SAMUEL SWIFT, FRANCIS W. WHITE, J. SHERMAN WIGHT, MESSRS. WILLIAM APPLETON AIKEN, HENRY A. ALKER, B. I. ASHMUN, EDWARD S. AVERY, WOODWARD BABCOCK, CHARLES CHANEY BAKER, HARRY S. BANDLER, C. D. BARNES, ROBT. I. BARR, EDWARD R. BARTON, H. C. BECKMAN, SIDNEY FORBES BECKWITH, E. R. T. BERGGREN, JOHN D. BROWN, HOWARD SUMNER CANDEE, HENRY B. CANNON, THEODORE W. CASE, C. H. B. CHAPIN, GEORGE CHASE, W. H. CLARK, JAMES LIDE COKER, HENRY A. COLGATE, RUSSELL COLGATE, HENRY E. COOPER, R. C. DAVIS, E. DE GOLYER, WYLLYS E. DOWD, JR., ROBERT D. EMMERICH, JACKSON EVANS, S. J. FELDMAN, FRANK B. FOSTER, LEO FREEDMAN, JOHN H. FULTON, GEORGE R. E. GILCHRIST, W. E. GLYN, WM. E. S. GRISWOLD, JOHN HARRIS GUTTERSON, SIDNEY HARRISON, WILLIAM HOLABIRD, CHARLES C. HOMER, JR., FRANK T. HULSWIT, ARTHUR M. HUNTER, C. L. HUTCHESON, WALTER N. KAHN, G. H. KENT, EMIL L. KIEGER, HERBERT T. KING, ALLAN F. KITCHEL, W. M. LADD, ALFRED LE BLANC, PERCIVAL MANCHESTER, SAMUEL G. MCCLURE, CHARLES MCKNIGHT, EDWARD J. NALLY, JAMES C. O'CONNOR, WILLIAM TAFT PITKIN, SHERBURNE PRESCOTT, GEORGE W. RAYNES, WM. S. SCARBOROUGH, E. H. SCOTT, WILLIAM PAINE SHEFFIELD, FRANK R. SHULL, I. SIBBERNSEN, CHAS. H. SIMMONS, B. HERBERT SMITH, ISAAC STERN, FREDERICK PHILIP STIEFF, JR., FREDERICK M. P. TAYLOR, GEORGE F. TITUS, H. O. UNDERWOOD, FRED VOGEL, JR., JUSTUS VON LENGERKE, ROGER B. WILLIAMS, JR., H. LEONARD WILTON, J. WALTER WOOD and T. B. YUILLE.

Associate Members, MESDAMES A. S. PIERCE, FREDERICK SUNDT, MISSES ABIGAIL H. BISHOP, LILIAN GILLETTE COOK, COLONEL CHARLES K. WINNE, U.S.A., MESSRS. W. L. CHAMBERS, P. R. CLUFF, HENRY W. CORNING, WALTER L. DUNHAM, CHARLES W. FARNHAM, RICHARD A. FEISS, ARTHUR L. A. HIMMELSTEIN, EDWIN HOYT, HOWARD F. MARSTON, F. C. MCMATH, BENJAMIN F. MYERS, F. B. RAY, CRAIGE MCCOMB SNADER and SAMUEL F. WADSWORTH.